HANDY

MECHANICAL POCKET COMPANION

FOR THE

ENGINEER, BUSINESS MAN & MECHANIC.

CONTAINING

TABLE OF METALS, STRENGTH OF MATERIALS, WAGES, BOARD MEASURE, SCANTLING MEASURE, CUTTING SCREWS BY LATHE, HORSE-POWER OF SHAFTING, BELTING, CIRCUMFERENCES, AREAS, SQUARES, CUBES, SQUARE ROOT, CUBE ROOT, ETC., ETC.

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PREFACE.

This little collation of authorities and culling of condensed and useful tables, rules, etc., is designed to meet a growing demand for something more practical and concise for the use of Mechanics, in all the different departments of Mechanical industries.

It has been arranged with great care, selected from the best authorities, just the right thing and an endeavor made to put them in the right place.

This volume gives more practical and less theoretical knowledge than can be found in any other book yet offered to the practical Mechanic, and at a price within the reach of all.

The idea has been to have this book published in such a shape that it can be carried in a pocket so that it may be referred to at any time.

A. W. H.

NAME, WHEN DISCOVERED, BY WHOM, SYMBOLS, COLOR AND SPECIFIC GRAVITY.

Name.	Dis-cov.	By whom.	Sy-m.	Color.	Sp'c. G'ty.
Aluminum.	1808	Davy.	Al	White	2.60
Antimony.	1460	Basil-Valentine	Sb	Bluish White	6.70
Arsenic.	1733	Brandt.	As	Gray	5.88
Barium.	1808	Davy.	Ba	Dark Gray	1.50
Bismuth.	1529	Agricola.	Bi	Yellow'h W'te	9.80
Boran.	1808	Davy.	B	White	2.00
Bromine.	1826	Balard.	Br	Brownish R'd	2.97
Cadmium.	1817	Stromeyer.	Cd	White	8.60
Cæsium.	1860	Bunsen.	Cs	Blue	1.50
Calcium.	1808	Davy.	Ca	White	3.52
Carbon.		Ancients.	C	Black	
Cerium.	1803	Berzelius.	Ce	Gray White	
Chlorine.	1774	Scheele.	Cl	Greenish	2.49
Chromium.	1797	Vanquelin.	Cr	Grayish W'te	6.00
Cobalt.	1733	Brandt.	Co	Gray White	8.90
Columbium.	1801	Hatchett.	Cb	Iron Gray	5.50
Copper.		Ancients.	Cu	Red	8.90
Didymium.	1841	Mosander.	D		
Erbium.	1841	Mosander.	E	White	
Fluorine.			F	Colorless	1.29
Gallium.	1875	Lecoq.	?		
Gold.		Ancients.	An	Yellow	19.26
Glucinum.	1828	Wohler.	G	White	
Hydrogen.	1766	Cavendish.	H	Colorless	.07
Indium.	1863	Reichter.	In	Bluish	7.42
Iodine.	1812	Courtois.	I	Grayish Bla'k	4.95
Iridium.	1803	Tennant.	Ir	White	18.68
Iron.		Ancients.	Fe	Bluish Gray	7.90
Lanthanum.	1841	Mosander.	La	Red	
Lead.		Ancients.	Pb	Blue	11.44
Lithium.	1817	Bunsen.	L	White	.59
Magnesium.	1808	Davy.	Mg	Silver White	3.70
Manganese.	1774	Gahn.	Mn	Gray White	8.00
Mercury.		Ancients.	Hg	White	13.60

CHEMICAL KINGDOM. (Continued.)

Name.	Dis-cov.	By Whom.	Sy-m.	Color.	S. G.
Molybdenum.	1782	Hjelm.	M	Gray	8.60
Nickel.	1751	Cronstedt.	Ni	White	8.80
Nitrogen.	1772	Rutheford.	N	Colorless	.97
Osmium.	1803	Tennant.	Os	Bluish Black	10.00
Oxygen.	1774	Priestley.	O	Colorless	1.11
Palladium.	1803	Wallaston.	Pd	Bluish Wh'te	11.80
Phosphorus.	1669	Brandt.	P	Yellow	2.00
Platinum.	1741	Wood.	Pt	Bluish Wh'te	21.50
Potassium	1807	Davy.	K	Gray White	.87
Rhodium.	1803	Wallaston.	Ro	Grayish W'te	10.60
Rubidium.	1860	Bunsen.	Rb	Red	
Ruthenium.	1847	Claus.	Ru	White	
Selenium.	1818	Berzelius.	Se	Dark Brown	4.32
Silicon.	1824	Berzelius.	Si	Brown	
Silver.		Ancients.	Ag	White	10.50
Sodium.	1808	Davy.	Na	Gray White	.97
Strontium.	1808	Davy.	Sr	Gray	2.50
Sulphur.		Ancients.	S	Yellow	1.99
Tantalum.	1802	Ekeberg.	Ta		
Tellurium.	1798	Klaproth.	Te	Bluish Wh'te	6.20
Thallium.	1861	Crookes.	Tl	Green	
Thorium.	1828	Berzelius.	Th	White	
Tin.		Ancients.	Su	White	7.30
Titanium.	1789	Gregor.	Ti	Red	5.30
Tungsten.	1781	De Layurt.	W	Brown'h B'k	7.40
Uranium.	1789	Klaproth	U	Gray	8.00
Vanadium.	1830	Sefstrom.	V	White	
Yttrium.	1828	Wohler.	Y	White	
Zinc.	1540	Paracelsus.	Zn	Bluish Wh'te	7.00
Zirconium.	1824	Berzelius.	Zr	White	

METAL BORING AND TURNING.

Boring Cast-Iron—Divide 25 by the diameter of the cylinder in inches for the revolutions per minute.

" Wrought-Iron—The speed is one fifth greater than for cast-iron.

" Brass—The speed is one half that, for cast-iron.

Turning Cast-Iron—The speed is twice that of boring.

" Wrought-Iron—The speed is one fifth greater than that for cast-iron.

" Brass—The speed is twice that of boring.

Verticle Boring—The speed may be twice that of horizontal boring.

The feed depends upon the stability of the machine and depth of cut.

IRON TURNING and BORING by means of the SLIDE REST.

Diameter in Inches.	Revolution of Spindle per Minute.	Diameter in Inches.	Revolution of Spindle per Minute.	Diameter in Inches.	Revolution of Boring bar per Minute.	Diameter in Inches.	Revolution of Boring bar per Minute.
1	50.	25	2.	1	25.	25	1.
2	25.	30	1.667	2	12.500	30	.833
3	16.67	35	1.430	3	8.330	35	.714
4	12.50	40	1.250	4	6.250	40	.425
5	10.	45	1.120	5	5.	45	.566
6	8.32	50	1.	6	4.160	50	.500
7	7.15	60	.834	7	3.570	60	.417
8	6.25	70	.716	8	3.125	70	.358
9	5.55	80	.626	9	2.770	80	.313
10	5.	90	.554	10	2.500	90	.278
15	3.33	100	.500	15	1.660	100	.250
20	2.50			20	1.250		

Velocities of Wood-working Machinery in Feet or Revolutions per Minute.

Circular Saws, at periphery, 6000 to 7000 feet.

Band Saws, 2500 feet.

Gang Saws, 20 inch stroke, 120 strokes, per minute.

Scroll Saws, 300 strokes, per minute.

Planing machine cutters at periphery, 4000 to 6000 feet.

Work under planing machine, 1-20 of an inch for each cut.

Molding-machine cutters, 3500 to 4000 feet.

Squaring-up-machine cutters, 7000 to 8000 feet.

Wood-Carving drills, 5000 revolutions.

Machine augers, 1½ inch in diameter, 900 revolutions.

Machine augers, ¾ inch in diameter, 1200 revolutions.

Gang Saws require for 45 superficial feet of pine per hour, one Horse Power.

Circular Saws require for 75 superficial feet of pine per hour, one Horse Power.

In oak or hard wood, ¾ ths of the above quantity require one Horse Power.

Table to calculate the Pitch of a Toothed Wheel when the radius and number of teeth are given; and the Radius, when the Pitch and number of teeth are given, from 10 to 159 teeth.

No. T'h	Radius.	No. T'h	Radius.	No. T'h	Radius.	No. T'h	Radius.	No. T'h	Radius.
10	1.618	40	6.373	70	11.144	100	15.918	130	20.692
11	1.774	41	6.532	71	11.303	101	16.077	131	20.851
12	1.932	42	6.691	72	11.463	102	16.236	132	21.010
13	2.089	43	6.850	73	11.622	103	16.395	133	21.169
14	2.247	44	7.009	74	11.781	104	16.554	134	21.328
15	2.405	45	7.168	75	11.940	105	16.713	135	21.488
16	2.563	46	7.327	76	12.099	106	16.873	136	21.647
17	2.721	47	7.486	77	12.258	107	17.032	137	21.806
18	2.869	48	7.645	78	12.417	108	17.191	138	21.965
19	3.038	49	7.804	79	12.576	109	17.350	139	22.124
20	3.196	50	7.963	80	12.735	110	17.509	140	22.283
21	3.355	51	8.122	81	12.895	111	17.668	141	22.442
22	3.513	52	8.281	82	13.054	112	17.827	142	22.602
23	3.672	53	8.440	83	13.213	113	17.987	143	22.761
24	3.830	54	8.599	84	13.370	114	18.146	144	22.920
25	3.989	55	8.758	85	13.531	115	18.305	145	23.079
26	4.148	56	8.917	86	13.690	116	18.464	146	23.238
27	4.307	57	9.076	87	13.849	117	18.623	147	23.397
28	4.465	58	9.235	88	14.008	118	18.782	148	23.556
29	4.624	59	9.394	89	14.168	119	18.941	149	23.716
30	4.788	60	9.553	90	14.327	120	19.101	150	23.874
31	4.942	61	9.712	91	14.486	121	19.260	151	24.034
32	5.101	62	9.872	92	14.645	122	19.419	152	24.193
33	5.260	63	10.031	93	14.804	123	19.578	153	24.352
34	5.419	64	10.190	94	14.963	124	19.737	154	24.511
35	5.578	65	10.349	95	15.122	125	19.896	155	24.620
36	5.737	66	10.508	96	15.281	126	20.055	156	24.830
37	5.896	67	10.667	97	15.440	127	20.214	157	24.989
38	6.055	68	10.826	98	15.600	128	20.374	158	25.148
39	6.214	69	10.985	99	15.759	129	20.533	159	25.307

Rule 1—Divide the required radius by the radius opposite the given number of teeth in the table; the quotient will be the required pitch of the wheel.

Example—To find the Pitch of a wheel whose radius is 43 inches, that shall contain 90 teeth.
Required radius $43 \div 14.327 = 3$ inch pitch.

Rule 2—Multiply the radius opposite the given number of teeth by the pitch required; the product will be the required radius of the wheel.

Example—To find the radius of a wheel that shall contain 48 teeth of $2\frac{1}{2}$ inch pitch.
In the table, radius $7.645 \times 2.5 = 19\frac{1}{10}$ inches nearly.

PROPORTION SCALES FOR GEARING.

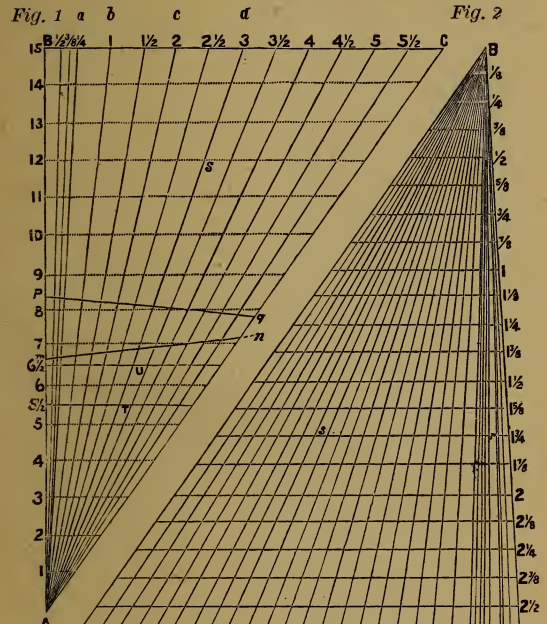

Figure 1 contains the proportions, in which the pitch is supposed to be divided into 15 equal parts.

The construction of this scale is very simple. Thus let A. B. be divided into 15 equal parts, and draw B. C. per-

pendicular to it; and again divide B. C. into a determinate number of parts from B. actual measures of the pitches for which the scale is intended to be used; that is, B a=½ inch; B b = 1 inch; B c = 2 inches, and so on, and join a and A, b and A, c and A, and so on. To complete the scale, draw 15 parallels to B C from the points numbered in the line A B, numbering their intersections (if thought proper) with the line A C in the same order; and also the two parallels T and U, (which are full lines in diagram,) equidistant from the parallels on each side of them.

The scale is thus ready for use, and its principle is self-evident. To get from it the several proportions for a given pitch, say 3 inches=B d, let the compasses be extended from the intersection of the parallel marked T, with the line A B, to the point where it intersects the line A d; this will be the part of the tooth from the pitch line to the point, and equivalent to 5½ parts of the pitch, (viz. of B d;) similarly the compasses being extended from the intersection of the parallel U, with the line A B, to its point of intersection of the line A d, will give the part of the length of the tooth from the pitch line to the root, and equivalent to 6½ parts of the pitch. For the whole length of the tooth (if wanted in one measurement) set the compasses to the point where the parallel marked 12 meets the line A B, and extend to its point of intersection of the line A d at s, the length is 12 parts of the pitch B d; the working depth is in like manner found from the parallel marked 11; the thickness from that marked 7; and the width of space from that marked 8. The proportions for any other given pitch comprised in the scale are found in precisely the same way, and if the scale be well constructed they may be measured off with the utmost accuracy. To save confusion it is, however, better in practice to insert in the diagram only those parallels, namely, T, U, 12, 11 8, 7, which are required; the others are not requisite, and by inattention may lead to error.

The description of the scale as here given supposes that lateral clearance is constantly $\frac{1}{15}$ of the pitch; but as it is commonly desired that this should vary slightly with the pitch relatively increasing as pitch decreases, two other lines, $m\,n$ and $p\,q$, have been introduced into the scale, to enable such modification to be adopted, should it be required. These lines are drawn at such angles as to give a clearance at 6 inches pitch of 1-18th, which is increased at ¾ inch pitch to $\frac{1}{10}$. From these lines the thickness and space are to be taken, instead of using the lines marked 7 and 8, setting the compasses in the points of intersection with the pitch lines, and extending perpendicularly to *the line* A B; in other words, the *shortest distance* from the point of intersection with the pitch line to the line A B, is the required measure of the space when the line $p\,q$ is taken, and of the thickness of tooth when the line $m\,n$ is taken.

Figure 2 is more complete than the one described, and when well constructed insures, with moderate care, a degree of accuracy and uniformity, in the construction of the various sizes of wheels for which it is employed, that can hardly be otherwise attained. The principle of its construction is in effect the same as that described, but its use is more extended; the diameter of the wheel being found from it simultaneously with the length and thickness of tooth, width of space, and clearances. The scale is adapted to wheels of all the pitches, from 1/2 inch up to 3 inches.

The mode of construction is this: having drawn the line A D of any convenient length, raise the perpendicular C B to it, also of any convenient length. On the line A D lay off the greatest pitch off the scale from C to A; then from C towards D lay of *seven* times the pitch *once* or *twice*, according to the sizes of wheels of which the scale is intended to be applied. In the scale given, double of seven times the pitch is laid off, namely, 42 inches; then each of these great divisions being subdivided into 11 equal parts, one of these parts will be equal to four teeth upon the radius of the wheel, so that the whole line C D will be divided into 88 radial pitches. Next on the line C B set off the pitches which may be required in the scale, and through these points draw the 24 parallels to A D, terminating in the lines A B and D B. Then each parallel measured from the line B C to its point of termination in B D, is the radius of a wheel of 88 teeth of the particular pitch marked against it on the line A B. They also express the radii of wheels having less than 88 teeth when measured only to the corresponding point in the line joining B, and the divisional on C D, against which the number of teeth is marked. Thus the radius of a wheel of 52 teeth and 1 7/8 pitch, is $r\ s = 15\frac{7}{16}$ inches very nearly.

The scale may also be used when the number of teeth exceeds 88; for example, to find the radius of a wheel having 100 teeth. Thus having found the radius answering to 88 teeth, upon the same parallel take off the measure answering to the difference 100−88=12 teeth; and the two measures together will be the radius required.

To adapt the scale to odd numbers of teeth, the first division on the right of C is divided into single radial pitches, so that the radius of any wheel may be measured off without having recourse to calculation of any kind Thus, for example, if the wheel is intended to contain 50 teeth, the compasses being extended from 52 to the intersection of the parallel answering to the particular pitch to where it meets the line joining Q and B, will give the radius required, that is, a radius answering to 52−2=50 teeth; and any other number of teeth when not marked against the base may be found in the same way.

For the proportions of the teeth, set off C $a = \frac{7}{10}$ of the pitch, then will A $a = \frac{3}{10}$ of the pitch, which corresponds to

the depth from the point of the tooth to the pitch line. Again, set off C $b = \frac{7}{10}$th of the 3 inch pitch, and $\frac{5}{11}$ on the parallel against the 1 inch pitch, this will be the thickness of the tooth, allowing from a *fifteenth* for clearance on the largest pitch, to a *tenth* on those from 7/8 inch and under; and A b will be the width of space, including the clearance. Lines being drawn from those points to B complete the diagram.

To use the scale, lay off the addendum of the tooth; that is, length beyond the pitch line, equal to A $a = \frac{3}{10}$ pitch, and the same length marked off within the pitch line will give the whole working depth of the tooth, namely, $\frac{6}{10}$ pitch. Then with the measure C $a = \frac{7}{10}$ pitch in the compasses, mark off the whole length of the tooth, and this will allow $\frac{1}{10}$ at the bottom for clearance. Again, set off the thickness of tooth = C b, and the space = A b which will contain the clearance for the particular pitch, varying from $\frac{1}{15}$ to fully $\frac{1}{10}$ on the small pitches.

The amount of bottom clearance is here presumed to be uniformly $\frac{1}{10}$ of the pitch; but if it be thought advisable to make this vary as in the case of the lateral clearance, it will then be necessary to insert a third line c B in the scale, and so related to a B that the space $a\ c$ shall be throughout equal to the depth of tooth from the pitch circle to the root, and giving any bottom clearance that may be desired.

Table of Diametral Pitch, with its Equivalent Circular Pitch Opposite on the Adjoining Column.

Diametral Pitch.	Circular Pitch.	Diametral Pitch.	Circular Pitch.	Circular Pitch.	Diametral Pitch.	Circular Pitch.	Diametral Pitch.
2	1.57	11	.280	$1\frac{3}{4}$ in.	1.79	$\frac{3}{4}$ in.	4.19
$2\frac{1}{2}$	1.39	12	.262	$1\frac{1}{2}$ "	2.09	$1\frac{1}{8}$ "	4.57
$2\frac{1}{2}$	1.25	14	.224	$1\frac{7}{16}$ "	2.18	$\frac{5}{8}$ "	5.03
$2\frac{3}{4}$	1.14	16	.196	$1\frac{3}{8}$ "	2.28	$\frac{9}{16}$ "	5.58
3	1.05	18	.174	$1\frac{5}{16}$ "	2.39	$\frac{1}{2}$ "	6.28
$3\frac{1}{2}$	.898	20	.157	$1\frac{1}{4}$ "	2.51	$\frac{7}{16}$ "	7.18
4	.785	22	.143	$1\frac{3}{16}$ "	2.65	$\frac{3}{8}$ "	8.38
5	.628	24	.130	$1\frac{1}{8}$ "	2.79	$\frac{5}{16}$ "	10.06
6	.524	26	.120	$1\frac{1}{16}$ "	2.96	$\frac{1}{4}$ "	12.56
7	.448	28	.112	1 "	3.14	$\frac{3}{16}$ "	16.75
8	.392	30	.104	$\frac{15}{16}$ "	3.35	$\frac{1}{8}$ "	25.12
9	.35	32	.098	$\frac{7}{8}$ "	3.59	$\frac{1}{16}$ "	50.24
10	.314			$\frac{13}{16}$ "	3.86		

Simple Rules on Gearing.

The following rules will apply to both Bevel and Spur Gears. When the term "pitch" is used it always signifies diametral (not circular) pitch.

For illustrations we will use gears having 64 teeth and 8 pitch.

To Find Pitch Diameter:—Divide the number of teeth by the pitch: 64÷8=8 in. p. diam.

To Find No. Of Teeth:—Multiply the pitch diam. by the pitch: 8 in.×8=64, No. of teeth.

To Find The Pitch:—Divide the number of teeth by the pitch diam. 64÷8 in.=8, pitch,

To Find Outside Diam. Of Spur Wheels:—Add 2 to the number of teeth and divide by the pitch: 64+2=66÷8=8¼ in. o. d.

To Find Circular Pitch:—Divide the decimal 3.1416 the diametrical pitch: 3.1416÷8=.3927 in.

To Find The Distance Between The Centers Of Two Spur Gears:—Divide half the sum of the teeth of both gears by the pitch: 64+64=128÷2=64÷8=8 in. centers.

A simple rule to determine the face of bevel gears is to make them seven times the pitch: 8 pitch bevel will thus be ⅞ in. face.

The following table gives the breadth of teeth for transmitting with safety, different powers at various speeds, under ordinary circumstances; the width being $2\frac{1}{10}$ times the pitch; for increasing the wear, however, in practice, with coarse pitch, the breadth is usually three or four times the pitch.

Pitch.	Thickness of Teeth.	Length of Teeth.	Breadth of Teeth.	Velocity of the wheel at the pitch Circle.				
				3 ft. per sec.	4 ft. per sec.	5 ft. per sec.	7 ft. per sec.	11 ft. per sec.
Ins.	Ins.	Ins.	Ins.	H.P.	H.P.	H.P.	H.P.	H.P.
4	1.9	2.8	8.5	19	$25\frac{1}{4}$	32	45	$70\frac{1}{2}$
$3\frac{1}{2}$	1.6	2.45	7.3	$14\frac{3}{4}$	$19\frac{1}{2}$	$24\frac{1}{2}$	$34\frac{1}{4}$	54
3	1.4	2.1	6.3	11	$14\frac{1}{2}$	18	25	$39\frac{1}{2}$
$2\frac{1}{2}$	1.2	1.75	5.2	$7\frac{1}{2}$	10	$12\frac{1}{2}$	$17\frac{1}{2}$	$27\frac{1}{2}$
2	0.95	1.4	4.2	$4\frac{3}{4}$	$6\frac{1}{4}$	8	11	$17\frac{1}{4}$
$1\frac{3}{4}$	0.88	1.22	3.6	$3\frac{1}{2}$	5	$6\frac{1}{4}$	$8\frac{1}{2}$	$13\frac{1}{2}$
$1\frac{1}{2}$	0.71	1.05	3.1	$2\frac{3}{4}$	$3\frac{1}{2}$	$4\frac{1}{2}$	$6\frac{1}{4}$	10
$1\frac{1}{4}$	0.59	0.87	2.6	2	$2\frac{1}{2}$	$3\frac{1}{8}$	$4\frac{1}{5}$	$6\frac{4}{5}$
$1\frac{1}{4}$	0.53	0.79	2.3	$1\frac{1}{2}$	$2\frac{1}{4}$	$2\frac{1}{2}$	$3\frac{1}{2}$	$5\frac{1}{2}$
1	0.48	0.7	2.1	$1\frac{1}{5}$	$1\frac{3}{5}$	2	$2\frac{4}{5}$	$4\frac{2}{5}$
$\frac{7}{8}$	0.41	0.61	1.82	1	$1\frac{2}{5}$	$1\frac{3}{4}$	$2\frac{1}{2}$	$3\frac{4}{5}$
$\frac{3}{4}$	0.36	0.52	1.57	$\frac{7}{10}$	$\frac{9}{10}$	$1\frac{1}{8}$	$1\frac{1}{2}$	$2\frac{1}{2}$
$\frac{5}{8}$	0.33	0.43	1.31	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	1	$1\frac{7}{10}$
$\frac{1}{2}$	0.24	0.35	1.05	$\frac{3}{10}$	$\frac{2}{5}$	$\frac{1}{2}$	$\frac{7}{10}$	$1\frac{1}{10}$

TABLE FOR CUTTING SCREWS BY LATHE.

No. of threads per in. of screw.	No. of Te'th Mandrel-Pinion.	No. of Te'th Leading screw wheel.
1	80	40
1¼	80	50
1½	80	60
1¾	80	70
2	90	90
2¼	80	90
2½	80	100
2¾	80	110
3	80	120
3¼	80	130
3½	80	140
3¾	80	150
4	40	80
4¼	40	85
4½	40	90
4¾	40	95
5	40	100
5½	40	110
6	40	120
6½	40	130
7	40	140
7½	40	150
8	30	120

No. of threads per in. of screw.	Number of Teeth. Mandrel-Pinion.	Stud-Wheel.	Stud-Pinion.	Leading screw wheel.
8¼	40	55	20	60
8½	90	85	20	90
8¾	60	70	20	75
9	90	90	20	95
9¼	40	60	20	65
10	60	75	20	80
10½	50	70	20	75
11	60	55	20	120
12	90	90	20	120
12¾	60	85	20	90
13	90	90	20	130
13¼	60	90	20	90
13¾	80	100	20	110
14	90	90	20	140
14¼	60	90	20	95
15	90	90	20	150
16	60	80	20	120
16½	80	100	20	130
16¾	80	110	20	120
17	45	85	20	90
17½	80	100	20	140

No. of threads per in. of screw.	Number of Teeth. Mandrel-Pinion.	Stud-Wheel.	Stud-Pinion.	Leading screw wheel.
18	40	60	20	120
18¾	80	100	20	150
19	50	95	20	100
19½	80	120	20	130
20	60	100	20	120
20¼	40	90	20	90
21	80	120	20	140
22	60	110	20	120
22½	80	120	20	150
22¾	80	130	20	140
23¾	40	95	20	100
24	65	120	20	130
25	60	100	20	150
25½	30	85	20	90
26	70	130	20	140
27	40	90	20	120
27½	40	100	20	110
28	75	140	20	150
28½	30	90	20	95
30	70	140	20	150

No. of threads per in. of screw.	Number of Teeth. Mandrel-Pinion.	Stud-Wheel.	Stud-Pinion.	Leading screw wheel.
32	30	80	20	120
33	40	110	20	120
34	30	85	20	120
35	60	140	20	150
36	30	90	20	120
38	30	95	20	120
39	40	120	20	130
40	30	100	20	120
42	50	140	20	150
44	30	110	20	120
45	30	90	20	150
45½	40	130	20	140
50	30	100	20	150
52	35	130	20	140
52½	40	140	20	150
55	30	110	20	150
56	30	120	20	140
60	30	120	20	150
65	30	130	20	150
70	30	140	20	150

The foregoing table shows the train of wheels to be used in cutting screws varying in pitch from 1 to 70 threads to the inch; the leading or guide screw is supposed to have two threads per inch, yet may the table be still employed when the leading screw has four threads to the inch, for the same train of wheels would suit for cutting screws of double fineness; and similarly when the leading screw has only 1 thread to the inch, a screw of only one-half the fineness will be produced with any train given in the table.

RULE for GEARING UP ENGINE LATHES for SCREW CUTTING.

Read from the lathe index the number of threads per inch cut by equal gears and multiply it by any number that will give for a product a gear on the index; put this gear upon the stud, then multiply the number of threads per inch to be cut by the same number and put the resulting gear upon the screw.

Example.—To cut 11½ threads per inch, We find on the index that 48 into 48 cuts 6 threads per inch, then

6×4=24, gear on stud,
and 11½×4=46, " " screw.

Any multiplier may be used so long as the products include gears that belong with the lathe. For instance, instead of 4 as a multiplier we may use 6.

Thus 6×6=36, gear upon stud,
and 11½×6=69, " " screw.

TABLE giving the proportions of the U. S. or SELLERS, STANDARD threads for screws, nuts and bolts.

Out Side Diam. of Screw in Inches.	Number of Threads per Inch.	Diam. of Screw at the Root of the Thread in Dec. of an Inch.	Width of Top and Bottom Thread in Dec. of an Inch.	Out Side Diam. of Screw in Inches.	Number of Threads per Inch.	Diam. of Screw at the Root of the Thread in Dec. of an.Inch.	Width of Top and Bottom Thread in Dec. of an Inch.
¼	20	.185	.0062	2	4½	1.712	.0277
5/16	18	.24	.0074	2¼	4½	1.962	.0277
3/8	16	.294	.0078	2½	4	2.176	.0312
7/16	14	.344	.0089	2¾	4	2.426	.0312
½	13	.4	.0096	3	3½	2.629	.0357
9/16	12	.454	.0104	3¼	3½	2.879	.0357
5/8	11	.507	.0113	3½	3½	3.1	.0384
11/16	10	.62	.0126	3¾	3	3.317	.0413
¾	9	.731	.0138	4	3	3.567	.0413
1	8	.837	.0156	4¼	2½	3.798	.0435
1¼	7	.94	.0178	4½	2¾	4.028	.0454
1¼	7	1.065	.0178	4¾	2⅝	4.256	.0476
1⅜	6	1.16	.0208	5	2½	4.48	.05
1½	6	1.284	.0208	5¼	2½	4.73	.05
1⅝	5½	1.389	.0227	5½	2⅜	4.953	.0526
1¾	5	1.491	.025	5¾	2⅜	5.203	.0526
1⅞	5	1.616	.025	6	2¼	5.423	.0555

TABLE showing the number of THREADS to the inch for each diameter of SCREW bolts and SCREW taps.

(ENGLISH STANDARD.)

Screw bolts.		*Screw taps.*					
				V-Threads.		Sq. Taper T's.	
Diam. in Ins.	Thre'ds to the Inch.	Diam. in Ins.	Thre'ds to the Inch.	Diam. in Ins.	T'ds to In.	Diam. in Ins.	T'ds to In.
3/16	24	2 1/4	4	6/16	18	6/16	9
1/4	20	2 1/2	4	3/8	16	3/8	9
5/16	18	2 3/4	3 1/2	7/16	14	7/16	8
3/8	16	3	3 1/2	1/2	12	1/2	7
7/16	14	3 1/4	3 1/4	9/16	11	9/16	7
1/2	12	3 1/2	3 1/4	5/8	11	5/8	7
5/8	11	3 3/4	3	11/16	10	11/16	7
3/4	10	4	3	3/4	10	3/4	6
7/8	9	4 1/4	2 7/8	13/16	9	13/16	6
1	8	4 1/2	2 7/8	7/8	9	7/8	6
1 1/8	7	4 3/4	2 3/4	15/16	8	15/16	6
1 1/4	7	5	2 3/4	1	8	1	5
1 3/8	6	5 1/4	2 5/8	1 1/8	7	1 1/8	4
1 1/2	6	5 1/2	2 5/8	1 1/4	7	1 1/4	4
1 5/8	5	5 3/4	2 1/2	1 3/8	6	1 3/8	3
1 3/4	5	6	2 1/2	1 1/2	6	1 1/2	3
1 7/8	4 1/2			1 5/8	5	1 5/8	2 3/4
2	4 1/2			1 3/4	5	1 3/4	2 1/2

Proportions of Flange and Solid half-lap Couplings.

Flange.								*Half-Lap.*				
Diam. of Shaft.	Diameter of Flange.	Thickness of Flange.	Diam. of Boss.	Depth of Boss.	No. of Bolts.	Diam. of Bolt.	Diam. of Circle of Bolts.	Diam. of Shaft.	T'ck's of Metal.	D. of Coupling.	Length of Coup.	Length of Lap.
Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins	Ins
1	5	3/4	2 1/4	2	3	1/2	3 1/2	1	1	3	5 1/4	1
1 1/2	6 1/2	7/8	3 1/4	2 1/2	3	5/8	4 3/4	1 1/2	1 1/2	4 1/2	6 3/4	1 3/8
2	8	1 1/16	4 1/4	3	4	3/4	6	2	1 3/4	5 1/2	8 1/4	1 3/4
2 1/2	9 1/2	1 3/16	5 1/4	3 1/2	4	7/8	7 1/4	2 1/2	2	6 1/2	9 3/4	2 1/8
3	11	1 3/8	6 1/4	4	4	1	8 1/2	3	2 1/8	7 1/4	10 7/8	2 1/2
3 1/2	12 1/2	1 1/2	7 1/8	4 1/2	4	1	9 3/4	3 1/2	2 3/8	8 1/4	12 3/8	2 7/8
4	14	1 5/8	8	5	6	1	11	4	2 1/2	9	13 1/2	3 1/4
4 1/2	15 1/2	1 7/8	8 7/8	5 1/2	6	1	12 1/2	4 1/2	2 5/8	9 3/4	14 5/8	3 3/8
5	17	2	9 3/4	6	6	1 1/8	13 1/2	5	2 3/4	10 1/2	15 3/4	4
6	20	2 1/4	11 1/2	7	6	1 3/8	16					

Flange Couplings are a common and useful kind for

small and medium shafts, up to about 6 in. diameter.

Solid Couplings are perhaps the best of all for small shafts up to, say, 4½ or 5 inches diameter, for large shafts they become clumsy and heavy.

TABLE of the DIAMETERS and CIRCUMFERENCES of angle iron hoops, with angles inside and outside. From 6 inch to 6 feet diameter.

Diameter.		Angle Outward Circumference.		Angle Inward Circumference.		Diameter.		Angle Outward Circumference.		Angle Inward Circumference.	
Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.	Ft.	in.
0	6	1	5½	1	8½	2	4	6	10	7	11¾
0	7	1	8¼	1	11⅞	2	5	7	1	8	3¼
0	8	1	11⅜	2	3⅜	2	6	7	3⅞	8	6¾
0	9	2	2⅝	2	6¾	2	7	7	6⅞	8	10⅛
0	10	2	5¼	2	10⅛	2	8	7	9¾	9	1½
0	11	2	8⅛	3	1⅝	2	9	8	0⅝	9	5
1	0	2	11⅛	3	5	2	10	8	3⅝	9	8⅜
1	1	3	2	3	8½	2	11	8	6½	9	11⅝
1	2	3	5	3	11⅞	3	0	8	9½	10	3¼
1	3	3	7⅞	4	3⅜	3	3	9	6¼	11	1½
1	4	3	10⅞	4	6¾	3	6	10	3	11	11¾
1	5	4	1¾	4	10⅛	3	9	10	11⅞	12	10
1	6	4	4¾	5	1⅝	4	0	11	8⅝	13	8⅜
1	7	4	7⅝	5	5	4	3	12	5½	14	6⅝
1	8	4	11⅝	5	8½	4	6	13	2¼	15	4⅞
1	9	5	1½	5	11⅞	4	9	13	11	16	3⅛
1	10	5	4⅜	6	3¼	5	0	14	7⅞	17	1½
1	11	5	7⅜	6	6¾	5	3	15	4⅝	17	11¾
2	0	5	10¼	6	10⅛	5	6	16	1⅜	18	10
2	1	6	¼	7	1⅜	5	9	16	10¼	19	8¼
2	2	6	4⅛	7	5	6	0	17	7	20	6½
2	3	6	7⅛	7	8⅜						

In the TABLE of *Angle Outwards*, the breadth or thickness of the Angle Iron must be *added* to the circumference; thus—suppose you require to form a ring of 2 inch Angle Iron, 1 ft. 6 in. inside diameter add 2 in. to the diameter=1 ft. 8 in. and you will find the circumference or length of Iron to be 4 ft. 11⅝ in.

In the TABLE of *Angle Inwards*, the above rule is *reversed*, and the breadth or thickness of Iron must be subtracted from the outside diameter; thus—required a ring of 3 in. Angle Iron 2 ft. outside diameter, subtract 3 in. from the diameter=1 ft. 9 in. and you will find the circumference or length of Iron to be 5 ft. 11⅞ in.

Table showing the proper thickness for Steam-Cylinders, from 6 to 90 inches in diameter.

Diam. of Cylinder.	Thick-ness.	Diam. of Cylinder.	Thick-ness.	Diam. of Cylinder.	Thick-ness.	Diam. of Cylinder.	Thick-ness.
Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
6	.44	28	1.595	50	2.75	72	3.905
8	.545	30	1.7	52	2.855	74	4.01
10	.65	32	1.805	54	2.96	76	4.115
12	.755	34	1.91	56	3.065	78	4.22
14	.86	36	2.015	58	3.17	80	4.325
16	.965	38	2.12	60	3.275	82	4.43
18	1.07	40	2.225	62	3.38	84	4.535
20	1.175	42	2.33	64	3.485	86	4.64
22	1.28	44	2.435	66	3.59	88	4.745
24	1.385	46	2.54	68	3.695	90	4.85
26	1.49	48	2.645	70	3.8		

PROPORTIONS of PLUMMER-BLOCKS.

Diam. of Bearing.	Length of Bearing.	Height to Center.	Length of Sole.		Center of Hold-down b't.		Diam. of Bolts.	Size of Holes for Bolts.
Ins.	Ins.	Ins.	Ft.	In.	Ft.	In.	Inches.	In. In.
$1\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$	0	9	0	7	$\frac{1}{2}$	$\frac{5}{8} \times 1$
2	3	$2\frac{3}{4}$	0	$10\frac{1}{2}$	0	8	$\frac{5}{8}$	$\frac{3}{4} \times 1\frac{1}{4}$
$2\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{4}$	1	0	0	$9\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4} \times 1\frac{1}{4}$
3	4	$3\frac{1}{2}$	1	$1\frac{1}{2}$	0	$10\frac{1}{2}$	$\frac{3}{4}$	$\frac{7}{8} \times 1\frac{1}{2}$
$3\frac{1}{2}$	$4\frac{1}{2}$	$3\frac{7}{8}$	1	3	0	$11\frac{1}{2}$	$\frac{3}{4}$	$\frac{7}{8} \times 1\frac{1}{2}$
4	5	$4\frac{1}{4}$	1	4	1	$0\frac{1}{2}$	$\frac{7}{8}$	$1 \times 1\frac{5}{8}$
$4\frac{1}{2}$	$5\frac{1}{2}$	$4\frac{5}{8}$	1	6	1	$1\frac{1}{2}$	1	$1\frac{1}{8} \times 1\frac{3}{4}$
5	6	$5\frac{1}{8}$	1	$7\frac{1}{2}$	1	3	$1\frac{1}{8}$	$1\frac{1}{4} \times 2$
$5\frac{1}{2}$	$6\frac{1}{2}$	$5\frac{3}{8}$	1	9	1	$4\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{3}{8} \times 2\frac{1}{4}$
6	7	$6\frac{1}{2}$	1	$10\frac{1}{2}$	1	5	$1\frac{1}{4}$	$1\frac{3}{8} \times 2\frac{1}{4}$
7	8	$7\frac{1}{2}$	2	1	1	7	$1\frac{1}{2}$	$1\frac{3}{4} \times 2\frac{3}{4}$
8	9	$8\frac{1}{2}$	2	5	1	11	$1\frac{3}{4}$	$2 \times 2\frac{3}{4}$
9	10	$9\frac{1}{2}$	2	$6\frac{1}{2}$	2	0	$1\frac{7}{8}$ Two	$1\frac{3}{4} \times 2\frac{3}{4}$
10	11	10	2	8	2	1	$1\frac{5}{8}$ "	$1\frac{7}{8} \times 2\frac{5}{8}$
11	12	11	2	10	2	3	$1\frac{3}{4}$ "	$2 \times 2\frac{3}{4}$
12	13	12	3	0	2	4	2 "	$2\frac{1}{4} \times 3$

Proportions of Sunk Keys for Wheels and Pulleys.

Diam. of shaft in Ins.	1	2	3	4	5	6
Breadth of key.	3/8	5/8	7/8	1 1/8	1 3/8	1 5/8
Thickness of key.	.25	.34	.43	.52	.61	.71
Depth sunk in shaft.	.10	.125	.15	.175	.20	.225
Depth sunk in wheel.	.15	.215	.28	.345	.41	.485

Diam. of shaft in Ins.	7	8	9	10	11	12
Breadth of key.	1 7/8	2 1/8	2 3/8	2 5/8	2 7/8	3 1/8
Thickness of key.	.80	.89	.98	1.07	1.16	1.25
Depth sunk in shaft.	.25	.275	.30	.325	.35	.375
Depth sunk in wheel.	.55	.615	.68	.745	.81	.875

The depth sunk in the shaft and in the wheel is measured at the side of the key, and not at its center.

The thickness of METAL round the EYE of PULLEYS.

Diam. of Pulley in feet.	Diameter of Shaft in Inches.					
	1	2	3	4	5	6
	Thickness round eye in inches.					
1	7/8	1	1 1/8			
2	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8
3		1 1/4	1 3/8	1 1/2	1 5/8	1 3/4
4		1 3/8	1 1/2	1 5/8	1 3/4	1 7/8
5		1 1/2	1 5/8	1 3/4	1 7/8	2
6			1 3/4	1 7/8	2	2 1/8
7			1 7/8	2	2 1/8	2 1/4
8			2	2 1/8	2 1/4	2 3/8
9			2 1/8	2 1/4	2 3/8	2 1/2

Table of the greatest admissible distances between the bearings of continuous shafts, subject to no transverse strain except from their own weights.

Diam. of shaft in Ins.	Distance between bearings in feet.		Diam. of shaft in Ins.	Distance between bearings in feet.	
	Wrought iron.	Steel.		Wrought iron.	Steel.
1	12.27	12.61	7	23.43	24.13
2	15.46	15.89	8	24.55	25.23
3	17.70	18.19	9	25.53	26.24
4	19.48	20.02	10	26.44	27.18
5	20.99	21.57	11	27.30	28.05
6	22.30	22.92	12	28.10	28.88

Average Cutter Speed and Feed on Soft Cast Iron Surfaces.

The figures are adapted to calculations in milling upon soft cast-iron surfaces, and are subject to change to accompany variations in condition and character of work. In order to figure accurately upon milling work, the speed of cutter and amount of feed per revolution must be observed —that known, the computation is simple, as follows: Multiply the number of revolutions of cutter per minute by the length of feed at one revolution and the product is inches per minute that can be milled. Allowing about 40 ft. per minute for surface speed of cutter, a 1½ inch cutter should run at 300 revolutions per minute, with a feed of 1-150 of an inch to a revolution, giving a result of 2 ins. of light milling per minute. An inch cutter would make 150 revolutions per minute, with a feed of 1-100 of an inch on a moderately heavy cut, allowing 1½ inches of milling per minute. A 3 inch cutter would run 50 revolutions per minute, with a feed of 1-50 of an inch on heavy work, giving a result of 1 inch of milling per minute. The above are examples selected from observed results in practical shop usage.

The following table of metallic baths is given in Parkes Chemical Essays.

No.	Edge tools to be tempered in the various baths.	Composition of the baths.		Tem. Far.
		Lead.	Tin.	
1	Lancets, in a bath composed of	7	4	420°
2	Other Surgical Instruments.	7½	4	430°
3	Razors, &c..	8	4	442°
4	Pen knives and some implements of Surgery.	8½	4	450°
5	Larger pen knives, scalpels &c,	10	4	470°
6	Scissors, shears, garden hoes, cold chisels, &c.	14	4	490°
7	Axes, firmer chisels, plane irons, pocket knives, &c.	19	4	509°
8	Table knives, large shears, &c.	30	4	530°
9	Swords, watch springs, &c.	48	4	550°
10	Large springs, daggers, augers, small fine saws, &c.	50	2	558°
11	Pit saws, hand saws, and some particular springs.	Boiling Linseed oil.		600°
12	Articles which we require to be still somwhat softer.	Melting Lead.		612°

TEMPERING STEEL.

1	Very pale straw yellow.	430°	Tools for
2	A shade of darker "	440°	metals.
3	Darker straw "	470°	For wood &
4	Still darker straw "	490°	screw taps.
5	A brown "	500°	Hatchets,
6	A yellow, tinged slightly with purple.	520°	chisels,
7	Light purple.	530°	saws, &c.
8	Dark "	550°	
9	Dark blue.	570°	Springs.
10	Paler "	590°	Too soft for
11	Still paler blue.	610°	the above
12	Still paler blue, with a tinge of green.	630°	purposes.

TEMPERING RECIPES.

CASE-HARDENING with PRUSSIATE of POTASH.—Heat the articles after polishing to a bright red, rub the surface over with the prussiate of potash, allow it to cool to a dull red, and immerse it in water.

CASE-HARDENING MIXTURES.—Three parts of prussiate of potash to one part of sal-ammoniac, mixed, or two parts of sal-ammoniac, two parts of bone dust, and one part of prussiate of potash.

CASE-HARDENING.—Place horn, hoof, bone-dust, or shreds of leather, together with the article to be case-hardened, in an iron box subject to a blood-red heat, then immerse the article in cold water.

TEMPERING BORING INSTRUMENTS.—Heat the tool to a blood-red heat; hammer it until it is nearly cold; reheat it to a blood-red heat, and plunge it into a mixture of 2 ozs. each of vitriol, soda, sal-ammoniac and spirits of nitre, 1 oz. of oil of vitriol, ½ oz. of saltpeter, and 3 gallons of water, retaining it there until it is cold.

TO GIVE IRON A TEMPER TO CUT PORPHYRY.—Make your iron red-hot, and plunge it into distilled water from nettles, and acanthus, or in the very juice pounded out from these plants.

TEMPERING BATHS FOR STEEL.—Twenty gallons of spermaceti oil; 20 lbs. beef suet rendered; 1 gallon of neats-foot oil; 1 lb of pitch; 3 lbs. black resin.

These two last articles must be previously melted together, and then added to the other ingredients; when the whole must be heated in a proper iron vessel, with a close cover fitted to it, until the moisture is entirely evaporated, and the composition will take fire on a flaming body being presented to its surface, but which must be instantly extinguished again by putting on the cover of the vessel.

This recipe will only last for a few weeks constant use.

For Saws &c.—The composition is 2 lbs. suet. and a ¼ lb. of beeswax to every gallon of whale-oil. these are boiled together, and will serve for thin works and most kinds of steel. The addition of black resin, to the extent of about 1 lb; to the gallon, makes it serve for thicker pieces and for those that refused to harden before; but the resin should be added with judgment, or works will become too hard and brittle. The composition is useless when it has been constantly employed for about a month; the period depends, however, on the extent to which it is used, and the, trough should be thoroughly cleaned out before new mixture is placed in it.

Practical Thickness in Decimals of an Inch of Good Plate Iron in Steam-Boilers, Single Riveted.

P—Steam pressure in pounds per square inch above atmosphere.

P.	Diameter of Boiler in Inches.														
	10	15	20	25	30	35	40	50	60	70	80	90	100	120	150
10	.10	.10	.11	.11	.12	.12	.13	.13	.14	.14	.15	.15	.15	.16	.17
15	.10	.10	.11	.12	.13	.13	.13	.14	.15	.15	.16	.18	.19	.19	.22
20	.11	.11	.12	.12	.13	.14	.14	.15	.16	.17	.18	.20	.20	.22	.26
25	.11	.12	.12	.13	.14	.15	.15	.16	.18	.19	.20	.22	.23	.25	.30
30	.12	.13	.13	.14	.14	.15	.16	.18	.19	.20	.22	.24	.25	.28	.33
40	.12	.13	.14	.15	.16	.16	.18	.20	.22	.24	.26	.28	.30	.34	.40
50	.13	.14	.15	.16	.18	.18	.20	.22	.25	.28	.30	.33	.35	.40	.47
60	.14	.14	.16	.17	.19	.20	.22	.25	.28	.32	.34	.37	.40	.46	.55
70	.14	.15	.17	.18	.20	.22	.24	.28	.31	.35	.38	.42	.45	.52	.60
80	.15	.16	.18	.20	.22	.23	.26	.30	.34	.38	.42	.46	.50	.58	.70
90	.15	.17	.19	.21	.24	.25	.28	.32	.37	.42	.46	.50	.55	.60	.77
100	.15	.18	.20	.22	.25	.27	.30	.35	.40	.45	.50	.55	.60	.70	.85
120	.16	.19	.22	.25	.28	.31	.34	.40	.46	.52	.58	.60	.70	.80	1.00
150	.17	.22	.26	.30	.33	.36	.40	.47	.55	.60	.70	.77	.85	1.00	1.20
200	.20	.25	.30	.35	.40	.45	.50	.60	.70	.80	.90	1.00	1.10	1.30	1.60

Facts for Boiler Makers.

Rankine's Riveting Rules.—Diameter of Rivet for Plates less than ½" thick to be equal to twice the thickness of the plate. For plates ½" and upwards 1½ times thickness of plate. The length of rivet iron required to make the "head" equals 2½ times the diameter of the rivet.

Boiler Maker's Rule.—In addition to the thickness of the plates the following allowance is made for the head, both giving the whole length of rivets.

RIVET.	COLD RIVETED.	HOT RIVETED.
3/8 inch.	5/8 inch.	.....
1/2 "	3/4 "	7/8 inch.
5/8 "	7/8 "	1 "
3/4 "	.....	1 1/8 "

For boilers the rivets are 1¾ inch from center to center in single riveting, and 2 inches in double riveting; flues the same.

To have a tight fit in the sections for a boiler or other tubular work, make the inside diameter of the inside tube equal to the inside diameter of the outside tube, less 6 times the thickness of the iron.

Fairbairn's Table of Dimensions of Rivets for Boilers.

Thick. of Plate in Inches.	Diam. of Rivet in Ins.	Length of Rivet to head in Ins.	Pitch in inches.	Lap in single Joints in Ins.	Lap in double Joints in Ins.	Equiv't. length of Head in Ins.
3/16	3/8	7/8	1 1/4	1 1/4	2 1/16	1/2
1/4	1/2	1 1/8	1 1/2	1 1/2	2 1/2	5/8
5/16	5/8	1 3/8	1 5/8	1 7/8	3 1/8	3/4
3/8	3/4	1 5/8	1 3/4	2	3 3/8	7/8
1/2	1 3/16	2 1/4	2	2 1/4	3 3/4	1 1/4
9/16	7/8	2 1/2	2 1/4	2 1/2	4 1/8	1 3/8
5/8	15/16	2 3/4	2 1/2	2 3/4	4 5/8	1 1/2
11/16	1	3	2 3/4	3	5	1 5/8
3/4	1 1/8	3 1/4	3	3 1/4	5 7/8	1 3/4

Lloyd's Rule for Shipbuilding.

Diam of Rivets.	5/8"		3/4"			7/8"			1"			
Thickness of Plates.	" 5/16	" 6/16	" 7/16	" 8/16	" 9/16	" 10/16	" 11/16	" 12/16	" 13/16	" 14/16	" 15/16	" 1

Rivets to be ¼" larger in diameter in the stem stern post, and keel.

Boiler pressure allowed as per Government Rule—Diameter of Boiler in inches.

For Iron 1-4 thick ÷ 4.620.
" " 5-16 " ÷ 5.775.
" " 3-8 " ÷ 6.930.

EXAMPLE.—Pressure allowed for Boiler 8 feet diameter, 3-8 iron, $8 \times 12 = 96 \div 6.930 = 72.18$ pounds.

Table showing the Diminution of Iron Boiler-Plates at High Temperatures; the maxim Tenacity being at 550°=65.000 lbs. per square inch.

Iron Boilers.

Temp. observed.	Dim. of Tenac'y obser'd.	Temp. observed.	Dim. of Tenac'y obser'd.
550°	.0000	824°	.2010
570°	.0869	932°	.3324
596°	.0899	947°	.3593
600°	.0964	1030°	.4478
630°	.1046	1111°	.5514
662°	.1155	1115°	.6000
722°	.1436	1159°	.6011
732°	.1491	1187°	.6352
734°	.1535	1237°	.6622
766°	.1589	1245°	.6715
770°	.1627	1317°	.7001

Table showing the Diminution of strength of Copper Boiler-Plates by addition to the Temperature the cohesion at 32° being 32.800 lbs. per square inch.

Copper Boilers.

Temp. above 32°	Dimi-nution.	Tem. above 32°	Dim-inution.
90°	.0175	660°	.3425
180°	.054	769°	.4398
270°	.0926	812°	.4944
360°	.1513	880°	.5581
450°	.2046	984°	.6691
460°	.2133	1000°	.6741
513°	.2446	1200°	.8861
529°	.2558	1300°	1.0000

Table Given Horse-Power of Boilers the Following Sizes: at 60 lbs. Pressure.

Diam. shell ins;	Length shell. ft.	Num. Tubes.	Length Tubes. Feet.	Diam. Tubes. Inches.	Heating surface Square Ft.	Horse-Power.	Diam. shell Ins.	Length shell. ft.	Num. Tubes.	Length Tubes. Feet.	Diam. Tubes. Inches.	Heating surface Square Ft.	Horse-Power.
72	18	70	18	4	1502	100	54	12	60	12	3	624	41
72	16	90	16	3½	1472	98	48	16	40	16	3½	683	46
72	16	112	16	3	1596	99	48	16	49	16	3	684	46
72	15	112	15	3	1400	93	48	15	49	15	3	642	43
60	18	65	18	3½	1200	80	48	14	49	14	3	600	40
60	17	65	17	3½	1148	76	48	13	49	13	3	555	37
60	16	65	16	3½	1075	72	48	12	49	12	3	513	34
60	16	80	16	3	1088	72	48	11	65	11	2½	542	36
60	15	80	15	3	1020	68	48	10	65	10	2½	495	33
60	14	80	14	3	952	63	42	15	38	15	3	508	34
60	13	80	13	3	884	59	42	14	38	14	3	476	32
54	18	50	18	3½	951	63	42	13	38	13	3	441	30
54	17	50	17	3½	900	60	42	12	38	12	3	408	27
54	16	50	16	3½	795	53	42	11	45	11	2½	390	26
54	16	60	16	3	832	55	42	10	45	10	2½	355	24
54	15	60	15	3	780	52	42	9	45	9	2½	320	22
54	14	60	14	3	728	48	42	8	45	8	2½	285	19
54	13	60	13	3	676	45	42	7	45	7	2½	248	16

ALLOYS and COMPOSITION.

Name of Metal.	Copper.	Zinc.	Tin.	Nickel.	Lead.	Antimony.	Bismuth.	Silver.	Cobalt of Iron.
Argentan.	55.	24.		21.					
Argentiferous.	50.	2.5	2.5	40.	2.5		Iron.	2.5	
Babbitts Metal.	3.7		89.			7.3			
Brass Common.	84.3	5.2	10.5						
" "	75.	25.							
" Engine bearings.	50.	1.8	6.5						
" Hard.	79.3	6.4	14.3						
" Loc'm'tive bearings.	50.	2.5	5.		5.				
" Math'ical Instrum'ts	92.2		7.8						
" Pinchbeck	80.	20.							
" R. Tombec	88.8	11.2							
" Rolled.	74.3	22.3	3.4						
" Tutenag.	50.	31.		19.					
" Tenacious.	88.9	2.8	8.3						
" Wheels.	90.		10.						
" White.	10.	80.	10.						
" Wire.	67.	33.							
" Glands.	65.	.5	8.						
" Yellow.	40.	20.							
" Richer.	50.	10.							
" Red.	70.	10.			5.				
Britannia me'l.			25.			2.5			
when fus'd add						2.5	25.		
Box metal.	80.	10.							
Bronze. Yellow.	100.8	46.8	2.4						
" Red.	130.5	19.5							
" Alloy.	80.	2.	18.						
" Cymbals.	80.		20.						
" Gun met'l.	90.		10.						
" "	93.		7.						
" Medals.	93.		7.						
" Statuary.	91.4	5.5	1.4		1.7				
Bell metal l'rge.	80.		20.						
Chinese Silver.	65.1	19.3		13.				2.48	12.
" w'te cop'er.	40.4	25.4	2.6	31.6					
Church Bells.	80.	5.6	10.1		4.3				
" "	69.		31.						
Clock "	72.		26.5				Iron.	1.5	
Electrotype m't.			4.		100.	3.			
Flanges to stand Brazing.	64.	2.			2.				

Alloys and Composition (Continued).

Name of Metal.	Copper.	Zinc.	Tin.	Nickel.	Lead.	Antimony.	Bismuth.	Iron.
German Silver.	33.3	33.4		33.3				
" "	40.4	25.4		31.6				2.6
" fine,	49.5	24.		24.				2.5
Gongs,	81.6		18.4					
Gun Metal for bearings.	90.3	9.7	.3					
House Bells.	77.		23.					
Lathe Bushes.	80.		20.					
Mach'ery b'r'gs.	87.5		12.5					
" " hard.	77.4	7.	15.6					
Metal that expands in co'ling.					75.	16.7	8.3	
Muntz Metal.	90.	60.						
Musical Bells.	87.5		12.5					
Nickel-Silver "com. English	60.	17.8		22.2				
Nickel-S. Parisian.	66.	13.6		19.3				
Pewter Best.			86.			14.		
"			80.		20.			
Printing Characters.					80.	20.		
Sheathi'g Metal	56.	45.						
Speculum "	66.		22.		Arsenic. 12.			
"	50.	21.	29.					
Stereotype Met.			10.		100.	16.		
Tough Br'ss Engine work.	100.	15.	15.					
Tough Brass heavy bearings.	160.	5.	25.					
Telescopic Mirrors.	66.6		33.4					
Temper	33.4		66.6					
White Metal.	11.	11.	42.6			85.2		
" " hard.	69.8	25.8	4.4					

Melting points of alloys.

Lead.	Tin.	Bismuth.	Melting Point.
2 parts	3 parts.	5 parts.	212 degrees.
1 "	4 "	5 "	246 "
	1 "	1 "	286 "
	2 "	1 "	336 "
2 "	3 "		334 "

Horse-power which can be safely carried by shafts for prime movers gears, well supported by bearings, and making 100 revolutions per minute.

Horse-power which can be safely transmitted by shafts making 100 revolutions per minute, in which the transverse strain, if any, need not be considered.

Diam. in Ins.	Wr'ght Iron.	Steel.	Cast-Iron.	Diam. in Ins.	Wr'ght Iron.	Steel.	Cast-Iron.
	H. P.	H. P.	H. P.		H. P.	H. P.	H. P.
1.20	1.00	1.60	0.60	1.20	2.00	3.20	1.20
1.25	1.95	3.12	1.17	1.25	3.90	6.24	2.34
1.50	3.37	5.39	2.03	1.50	6.74	10.78	4.06
1.75	5.36	8.58	3.22	1.75	10.72	17.16	6.44
2.00	8.00	12.80	4.80	2.00	16.00	25.60	9.60
2.25	11.39	18.22	6.83	2.25	22.78	36.44	13.66
2.50	15.62	24.99	9.37	2.50	31.24	49.98	18.74
2.75	20.80	33.28	12.48	2.75	41.60	66.56	24.96
3.00	27.00	43.20	16.20	3.00	54.00	86.40	32.40
3.25	34.33	54.93	20.60	3.25	68.56	109.86	41.20
3.50	42.87	68.59	25.72	3.50	85.74	137.18	51.44
3.75	52.73	84.37	31.64	3.75	105.46	168.74	63.28
4.00	64.00	102.40	38.40	4.00	128.00	204.80	76.80
4.25	76.77	122.83	46.06	4.25	153.54	245.66	92.12
4.50	91.12	145.79	54.67	4.50	182.24	291.58	109.34
4.75	107.17	171.47	64.30	4.75	214.34	342.94	128.60
5.00	125.00	200.00	75.00	5.00	250.00	400.00	150.00
5.25	144.70	231.52	86.82	5.25	289.40	463.04	173.64
5.50	166.37	266.19	99.82	5.50	332.74	532.38	199.64
5.75	190.11	304.18	114.06	5.75	380.22	608.36	228.12
6.00	216.00	345.60	129.60	6.00	432.00	691.20	259.20
6.25	244.14	390.62	146.49	6.25	488.28	781.24	292.98
6.50	274.62	439.39	164.78	6.50	549.24	878.78	329.56
6.75	307.55	492.08	184.53	6.75	615.10	984.16	369.06
7.00	343.00	548.80	205.80	7.00	686.00	1097.60	411.60
7.25	381.08	609.73	228.65	7.25	762.16	1219.46	457.30
7.50	421.87	674.99	253.13	7.50	843.74	1349.98	506.26
7.75	465.48	744.77	279.29	7.75	930.96	1489.54	558.58
8.00	512.00	819.20	307.20	8.00	1024.00	1638.40	614.40
8.25	561.52	898.43	336.91	8.25	1123.04	1796.86	673.82
8.50	614.12	982.59	368.47	8.50	1228.24	1965.18	736.94
8.75	669.92	1071.87	401.95	8.75	1339.84	2143.74	803.90
9.00	729.00	1166.40	437.40	9.00	1458.00	2332.87	874.80
9.25	791.45	1266.32	474.87	9.25	1582.90	2532.64	949.74
9.50	857.37	1371.79	514.43	9.50	1714.74	2743.58	1028.86
9.75	926.86	1482.98	556.12	9.75	1853.72	2965.96	1112.24
10.00	1000.00	1600.00	600.00	10.00	2000.00	3200.00	1200.00

RULE:—Multiply the power given in the Tables by the number of revolutions made by the shaft per minute; divide the product by 100; the quotient will be the power which can be safely carried.

TABLE of the DIAMETER of SHAFTS BEING the FIRST MOVERS.

Horse Power.	REVOLUTIONS per MINUTE.																			
	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
	DIAMETER of SHAFTS in INCHES.																			
4	5.5	4.8	4.5	4.	3.7	3.6	3.5	3.3	3.2	3.1	3.	2.9	2.8	2.8	2.7	2.7	2.6	2.6	2.6	2.5
5	5.9	5.1	4.7	4.4	4.1	3.9	3.7	3.6	3.5	3.3	3.2	3.1	3.1	3.	3.	2.9	2.9	2.8	2.8	2.7
6	6.3	5.5	5.	4.6	4.4	4.1	4.	3.8	3.7	3.6	3.5	3.4	3.4	3.3	3.2	3.2	3.	3.	2.9	2.9
7	6.6	5.8	5.2	4.9	4.6	4.4	4.2	4.	3.9	3.7	3.6	3.5	3.5	3.4	3.4	3.3	3.3	3.2	3.1	3.1
8	6.9	6.	5.5	5.1	4.8	4.6	4.4	4.2	4.1	4.	3.9	3.8	3.7	3.6	3.5	3.5	3.4	3.4	3.3	3.2
9	7.2	6.3	5.7	5.5	5.	4.8	4.5	4.4	4.2	4.1	4.	3.9	3.7	3.7	3.6	3.6	3.5	3.5	3.4	3.3
10	7.4	6.6	5.9	5.6	5.2	4.9	4.7	4.6	4.4	4.2	4.1	4.	3.9	3.8	3.7	3.7	3.6	3.6	3.5	3.4
12	7.9	6.9	6.3	5.8	5.6	5.4	5.2	5.	4.8	4.6	4.4	4.3	4.2	4.1	4.	3.9	3.8	3.8	3.7	3.6
14	8.3	7.2	6.7	6.2	5.9	5.6	5.4	5.2	5.	4.7	4.5	4.4	4.4	4.3	4.2	4.1	4.	4.	3.9	3.8
16	8.7	7.6	7.1	6.6	6.1	5.8	5.6	5.4	5.2	5.	4.8	4.7	4.6	4.5	4.4	4.4	4.3	4.2	4.1	4.
18	9.	7.9	7.5	7.	6.6	6.2	5.8	5.6	5.4	5.2	5.	4.9	4.8	4.7	4.6	4.5	4.4	4.3	4.2	4.2
20	9.3	8.1	7.7	7.2	6.8	6.4	5.9	5.7	5.6	5.4	5.2	5.1	5.	4.8	4.6	4.6	4.5	4.5	4.4	4.4
25	10.	8.5	8.	7.4	7.1	6.8	6.3	6.	5.9	5.6	5.5	5.4	5.3	5.2	5.1	4.9	4.8	4.7	4.6	4.6
30	10.7	9.3	8.4	7.9	7.4	7.1	6.9	6.7	6.5	6.3	5.9	5.8	5.7	5.6	5.5	5.3	5.2	5.1	5.	4.9
35	11.4	9.8	8.9	8.4	7.9	7.4	7.1	6.9	6.6	6.5	6.3	6.1	5.9	5.7	5.6	5.5	5.4	5.3	5.2	5.2
40	11.7	10.5	9.3	8.8	8.3	7.8	7.4	7.2	6.9	6.7	6.6	6.4	6.2	6.	5.9	5.8	5.7	5.6	5.6	5.5
45	12.	10.6	9.7	9.2	8.7	8.1	7.6	7.4	7.	6.8	6.7	6.5	6.4	6.2	6.1	6.	5.9	5.8	5.7	5.6
50	12.6	11.	10.	9.3	9·	8.5	8.	7.8	7.4	7.3	7.2	6.9	6.5	6.6	6.5	6.4	6.2	6.	5.9	5.8
55	13.4	11.4	10.4	9.8	9.1	8.8	8.4	8.	7.5	7.4	7.3	7.2	7.	6.7	6.6	6.5	6.3	6.2	6.1	6.
60	13.6	12.	10.8	10.	9.3	9.	8.6	8.2	7.7	7.6	7.4	7.3	7.2	6.9	6.8	6.8	6.7	6.6	6.4	6.2

The Diameter of shafts used as second movers, or for driving machinery, will be found by dividing the number in the table by 1.25.

The Diameter of small shafts in mills, &c, will be found by dividing the number by 1.56.

Transmitting Efficiency of Iron shafting at different speeds, as Prime mover or Head shaft carrying Main Driving Pulley or gear well supported by bearings.

Cold Rolled Iron Shafting.

Diam. of Shaft. Ins.	Number of Revolutions per Minute.								
	60	80	100	125	150	175	200	250	300
	Horse-Power.								
1½	2.7	3.6	4.5	5.6	6.7	7.9	9.0	11.	13.
1¾	4.3	5.6	7.1	8.9	10.6	12.4	14.2	18.	21.
2	6.4	8.5	10.7	13.	16.	19.	21.	26.	32.
2¼	9.	12.	15.	19.	23.	26.	30.	38.	46.
2½	12.	17.	21.	26.	31.	36.	41.	52.	62.
2¾	16.	22.	27.	34.	41.	48.	55.	70.	82.
3	21.	29.	36.	45.	54.	63.	72.	90.	108.
3¼	27.	36.	45.	57.	68.	80.	91.	114.	136.
3½	34.	45.	57.	71.	87.	100.	114.	142.	172.
3¾	42.	56.	70.	87.	105.	123.	140.	174.	210.
4	51.	69.	82.	106.	128.	149.	170.	212.	256.
4½	73.	97.	121.	151.	182.	212.	243.	302.	364.

Turned Iron Shafting.

Diam. of Shaft. Ins.	Number of Revolutions per Minute.								
	60	80	100	125	150	175	200	250	300
	Horse-Power.								
1¾	2.6	3.4	4.3	5.4	6.4	7.5	8.6	10.7	12.9
2	3.8	5.1	6.4	8.	9.6	11.2	12.8	16.	19.2
2¼	5.4	7.3	8.1	10.	12.	14.	16.	20.	24.
2½	7.5	10.	12.5	15.	18.	22.	25.	31.	37.
2¾	10.	13.	16.	20.	24.	28.	32.	40.	48.
3	13.	17.	20.	25.	30.	35.	40.	50.	60.
3¼	16.	22.	27.	34.	40.	47.	54.	67.	81.
3½	20.	27.	34.	42.	51.	59.	68.	85.	102.
3¾	25.	33.	42.	52.	63.	73.	84.	105.	126.
4	30.	41.	51.	64.	76.	89.	102.	127.	153.
4½	43.	58.	72.	90.	108.	126.	144.	180.	216.
5	60.	80.	100.	125.	150.	175.	200.	250.	300.

To find the Horse-Power of other speeds not in the table.

Rule.—Multiply the power given in the 100 revolutions column, by the number of revolutions made by the shaft per minute; divide the product by 100; the quotient will be the power which can be safely carried.

Transmitting Efficiency of Iron shafting at different speeds, as Second movers or Line shafting, Bearings 8 feet apart.

Cold Rolled Iron Shafting.

Diam. of Shaft. Ins.	Number of Revolutions per Minute.								
	100	125	150	175	200	225	250	300	350
	Horse-Power.								
1½	6.7	8.4	10.1	11.8	13.5	15·2	16.8	20.	23.
1⅝	8.6	10.7	12.8	15.	17.1	19.3	21.5	26.	31.
1¾	10.7	13.4	16.	18.7	21.5	24.2	26.8	32.	39.
1⅞	13.2	16.5	19.7	23.	26.4	29.6	32.9	39.	46.
2	16.	20.	24.	28.	32.	36.	40.	48.	56.
2⅛	19.	24.	29.	33.	38.	43.	48.	57.	67.
2¼	22.	28.	34.	39.	45.	50.	56.	68.	80.
2⅜	27.	33.	40.	47.	53.	60.	67.	70.	94.
2½	31.	39.	47.	54.	62.	69.	78.	93.	109.
2¾	41.	52.	62.	73.	83.	93.	104.	125.	145.
3	54.	67.	81.	94.	108.	121.	134.	162.	189.
3¼	68.	86.	103.	120.	137.	154.	172.	205.	240.

Turned Iron Shafting.

Diam. of Shaft. Ins.	Number of Revolutions per Minute.								
	100	125	150	175	200	225	250	300	350
	Horse-Power.								
1¾	6.	7.4	8.9	10.4	11.9	13.4	14.9	17.9	20.9
1⅞	7.3	9.1	10.9	12.7	14.5	16.3	18.2	21.8	25.4
2	8.9	11.1	13.3	15.5	17.7	20.	22.2	26.6	31.
2⅛	10.6	13.2	15.9	18.5	21.2	23.8	26.5	31.8	37.
2¼	12.6	15.8	19.	22.	25.	28.	31.	38.	44.
2⅜	15.	18.	22.	26.	29.	33.	37.	44.	52.
2½	17.	21.	27.	30.	34.	39.	43.	52.	60.
2¾	23.	29.	34.	40.	46.	52.	58.	69.	81.
3	30.	37.	45.	52.	60.	67.	75.	90.	105.
3¼	38.	47.	57.	66.	76.	85.	95.	114.	133.
3½	47.	59.	71.	83.	95.	107.	119.	143.	167.
4	71.	89.	107.	125.	142.	160.	178.	213.	249.

To find the Horse-Power of other speeds not in the table.

Rule.—Multiply the power given in the 100 revolutions column, by the number of revolutions made by the shaft per minute; divide the product by 100; the quotient will be the power which can be safely carried.

Transmitting Efficiency of Iron shafting for simply Transmitting Power and short counters.

COLD ROLLED IRON SHAFTING.

Diam. of Shaft. Ins.	Number of Revolutions per Minute.								
	100	125	150	175	200	267	300	367	400
	HORSE-POWER.								
1¼	6.5	8.1	9.7	11.3	13.	17.4	19.5	23.9	26.
1⅜	8.5	10.7	12.8	15.	17.	22.7	25.5	31.	34.
1½	11.2	14.	16.8	19.6	22.5	30.	33.	41.	45.
1⅝	14.2	17.7	21.2	24.8	28.4	38.	42.	52.	57.
1¾	18.	22.	27.	31.	35.	47.	53.	65.	71.
1⅞	22.	27.	33.	38.	44.	58.	65.	79.	87.
2	26.	33.	40.	46.	53.	71.	80.	97.	106.
2⅛	32.	40.	47.	55.	63.	84.	95.	116.	127.
2¼	38.	47.	57.	66.	76.	101.	114.	138.	152.
2⅜	44.	55.	66.	77.	88.	118.	133.	163.	178.
2½	52.	65.	78.	91.	104.	138.	155.	190.	207.
2¾	69.	84.	99.	113.	138.	184.	207.	254.	277.

TURNED IRON SHAFTING.

Diam. of Shaft. Ins.	Number of Revolutions per Minute.								
	100	125	150	175	200	267	300	367	400
	HORSE-POWER.								
1½	6.7	8.4	10.1	11.8	13.5	17.9	20.3	24.8	27.
1⅝	8.6	10.7	12.8	15.	17.1	22.8	25.8	31.5	34.3
1¾	10.7	13.4	16.	18.7	21.5	28.	32.	39.	43.
1⅞	13.2	16.5	19.7	23.	26.4	35.	39.	48.	52.
2	16.	20.	24.	28.	32.	42.	48.	58.	64.
2⅛	19.	24.	29.	33.	38.	51.	57.	70.	76.
2¼	22.	28.	34.	39.	45.	60.	68.	83.	90.
2⅜	27.	33.	40.	47.	53.	70.	79.	96.	105.
2½	31.	39.	47.	54.	62.	83.	93.	114.	125.
2¾	41.	52.	62.	73.	83.	111.	125.	153.	167.
3	54.	67.	81.	94.	108.	144.	162.	198.	216.
3¼	68.	86.	103.	120.	137.	182.	205.	250.	273.

To find the Horse-Power of other speeds not in the table.

RULE.—Multiply the power given in the 100 revolutions column, by the number of revolutions made by the shaft per minute; divide the product by 100; the quotient will be the power which can be safely carried.

Table of Horse-Power which may be transmitted by open Single Belts to Pulleys running 100 Revolutions per minute. The diameters of the Driving and Driven Pulley being equal.

Diam. of Pulley.	Width of Belt in Inches.							
	2	2½	3	3½	4	4½	5	6
	Horse-Power.							
Ins.								
6	.44	.54	.65	.76	.87	.98	1.09	1.31
6½	.47	.59	.71	.83	.95	1.07	1.19	1.42
7	.51	.64	.76	.89	1.01	1.14	1.27	1.53
7½	.55	.68	.82	.95	1.09	1.23	1.36	1.64
8	.58	.73	.87	1.02	1.16	1.31	1.45	1.75
8½	.62	.77	.93	1.08	1.24	1.39	1.55	1.86
9	.65	.82	.98	1.15	1.31	1.48	1.64	1.97
9½	.69	.86	1.04	1.21	1.39	1.56	1.74	2.08
10	.73	.91	1.09	1.27	1.45	1.63	1.81	2.18
11	.80	1.00	1.20	1.40	1.60	1.80	2.00	2.40
12	.87	1.09	1.31	1.53	1.75	1.97	2.18	2.62
13	.95	1.18	1.41	1.65	1.89	2.12	2.36	2.83
14	1.02	1.27	1.52	1.77	2.02	2.27	2.53	3.05
15	1.09	1.36	1.64	1.91	2.19	2.46	2.73	3.29
16	1.16	1.45	1.74	2.03	2.32	2.61	2.91	3.48
17	1.24	1.55	1.85	2.16	2.47	2.78	3.09	3.70
18	1.31	1.64	1.96	2.29	2.62	2.95	3.27	3.92
19	1.39	1.73	2.07	2.42	2.76	3.11	3.45	4.14
20	1.45	1.82	2.18	2.55	2.91	3.27	3.64	4.36
21	1.52	1.91	2.29	2.67	3.05	3.44	3.82	4.58
22	1.60	2.00	2.40	2.80	3.20	3.60	4.	4.80
23	1.67	2.09	2.51	2.93	3.35	3.75	4.18	5.02

Diam. of Pulley.	Width of Belt in Inches.							
	4	5	6	8	10	12	14	16
	Horse-Power.							
Ins.								
24	3.5	4.4	5.2	7.	8.7	10.5	12.2	14.
25	3.6	4.5	5.5	7.3	9.1	10.9	12.7	14.5
26	3.8	4.7	5.7	7.6	9.5	11.3	13.2	15.1
27	3.9	4.9	5.9	7.8	9.8	11.8	13.7	15.6
28	4.1	5.1	6.1	8.1	10.2	12.2	14.3	16.3
29	4.2	5.3	6.3	8.4	10.5	12.6	14.8	16.9
30	4.4	5.4	6.6	8.7	10.9	13.1	15.3	17.4
31	4.5	5.6	6.8	9.	11.3	13.5	15.8	18.
32	4.7	5.8	7.	9.3	11.6	14.	16.3	18.6
33	4.8	6.	7.2	9.6	12.	14.4	16.8	19.2
34	4.9	6.2	7.4	9.9	12.4	14.8	17.3	19.8
35	5.1	6.4	7.6	10.2	12.7	15.3	17.9	20.4

HORSE-POWER OF BELTS—(Continued).

Diam. of Pulley.	Width of Belt in Inches.							
	4	5	6	8	10	12	14	16
	HORSE-POWER.							
36	5.2	6.5	7.8	10.5	13.1	15.7	18.3	20.9
37	5.4	6.7	8.1	10.8	13.5	16.2	18.9	21.5
38	5.5	6.9	8.3	11.	13.8	16.6	19.3	22.1
39	5.7	7.1	8.5	11.3	14.2	17.	19.9	22.7
40	5.8	7.3	8.7	11.6	14.7	17.5	20.4	23.3
42	6.1	7.6	9.2	12.2	15.3	18.2	21.4	24.3
44	6.4	8.	9.6	12.8	16.	19.2	22.4	25.6
46	6.7	8.4	10.	13.4	16.7	20.1	23.4	26.8
48	7.	8.8	10.4	14.	17.4	21.	24.4	28.
50	7.2	9.	10.9	14.6	18.2	21.8	25.4	29.
54	7.8	9.8	11.8	15.6	19.6	23.6	26.4	31.2
60	8.8	10.8	13.1	17.4	21.8	26.2	30.6	34.8
66	9.6	12.	14.4	19.2	24.	28.8	33.6	38.4
72	10.4	13.	15.6	21.	26.2	31.4	36.6	41.8
78	11.4	14.2	17.	22.6	28.4	34.	39.8	45.4
84	12.2	15.2	19.4	24.4	30.6	36.4	42.8	48.6

Diam. of Pulley.	Width of Belt in Inches.							
	18	20	22	24	26	28	30	32
	HORSE-POWER.							
Ins.								
24	16	17	19	21	23	24	26	28
30	19	22	24	26	28	31	33	35
36	24	26	29	31	34	37	39	42
38	25	28	30	33	36	39	41	44
40	26	29	32	35	38	41	44	47
42	28	31	34	36	40	43	46	49
44	29	32	35	38	42	45	48	51
48	31	35	38	42	45	49	52	56
50	33	36	40	44	47	51	54	58
54	35	39	43	47	50	53	58	62
60	39	44	48	52	57	61	65	70
66	43	48	53	58	62	67	72	77
72	47	52	58	63	68	73	78	84
78	51	57	62	68	74	80	85	91
84	55	61	67	73	79	86	91	97
96	63	70	76	84	90	98	104	112
120	78	88	96	104	114	122	130	140
144	94	104	116	126	136	146	156	168

The Horse-Power of Double Belts is 10-7 of that given in the Tables.

RULE:--Multiply the power given in the Tables by the number of revolutions made by the pulley per minute; divide the product by 100, the quotient will be the power transmitted.

The following table exhibits the necessary width of belts to transmit different number of Horse-Power.

Horse-Power.	Diameter of Pulleys and Drums in feet.								
	2	3	4	5	6	7	8	9	10
	Width of Belt in Inches.								
1	1.8	1.2	0.9	0.7	0.6	0.5	0.45	0.4	0.3
2	3.6	2.4	1.8	1.4	1.2	1.0	0.9	0.8	0.7
3	5.4	3.6	2.7	2.1	1.8	1.5	1.3	1.2	1.0
4	7.2	4.8	3.6	2.9	2.4	2.0	1.8	1.6	1.4
5	9.0	6.0	4.5	3.6	3.0	2.5	2.2	2.0	1.8
6	10.8	7.2	5.4	4.3	3.6	3.0	2.7	2.4	2.1
7	12.6	8.4	6.3	5.0	4.2	3.5	3.1	2.8	2.5
8	14.4	9.6	7.2	5.7	4.8	4.1	3.6	3.2	2.8
9	16.2	10.8	8.1	6.4	5.4	4.6	4.0	3.6	3.2
10	18.0	12.0	9.0	7.2	6.0	5.1	4.5	4.0	3.6
12	21.6	14.4	10.0	8.6	7.2	6.1	5.4	4.8	4.3
14	25.2	16.8	12.6	10.0	8.4	7.1	6.3	5.6	5.0
16	28.8	19.2	14.4	11.5	9.6	8.2	7.2	6.4	5.7
18	32.4	21.6	16.2	12.9	10.8	9.2	8.1	7.2	6.4
20	36.0	24.0	18.0	14.4	12.0	10.2	9.0	8.0	7.2
25	45.0	30.0	22.5	18.0	15.0	12.8	11.2	10.0	9.0
30	54.0	36.0	27.0	21.6	18.0	15.4	13.5	12.0	10.8
35	63.0	42.0	31.5	25.2	21.0	17.9	15.7	14.0	12.6
40	72.0	48.0	36.0	28.8	24.0	20.5	18.0	16.0	14.4
45	81.0	54.0	40.5	32.4	27.0	23.1	20.2	18.0	16.2
50	90.0	60.0	45.0	36.0	30.0	25.7	22.5	20.0	18.0
55		66.0	49.5	39.6	33.0	28.2	24.7	22.0	19.8
60		72.0	54.0	43.2	36.0	30.8	27.0	24.0	21.6
65		78.0	58.5	46.8	39.0	33.4	29.2	26.0	23.4
70		84.0	63.0	50.4	42.0	35.9	31.5	28.0	25.2
75			67.5	54.0	45.0	38.5	33.7	30.0	27.0
80			72.0	57.6	48.0	41.1	36.0	32.0	28.8
85			76.0	61.2	51.0	43.6	38.2	34.0	30.6
90			81.0	64.8	54.0	46.2	40.5	36.0	32.4
95				68.4	57.0	48.8	42.9	38.0	34.2
100				72.0	60.0	51.4	45.0	40.0	36.0

EXAMPLE.—What should be the width of belt to transmit 14 horse-power from a water wheel, having on its shaft a 5 feet drum. Find 14 in column marked "Horse-Power." opposite this number in the table, in the column 5, marked "Diameter of Pulleys and Drums in feet," will be found 10 inches, which is the required width of belt.

Remarks on Belting.

The average thickness of single belts is 3-16 of an inch, and when made of good ox-hide, well tanned, their breaking strength, per inch of width, has been determined as follows;

In the solid leather,	675 lbs.
At the rivet holes of splices,	362 "
At the lacing holes,	210 "

The safe working tension is assumed to be 45 lbs. per inch of width, which is equal to a velocity of about 60 square feet per minute per horse-power, which is safe practice for single belts in good condition.

About three-quarters of the trouble experienced in broken pulleys, hot boxes, etc., can be traced to the fault of tight belts.

The smooth side of the belt should run next to the pulley, as it will drive 25 per cent. more than if run with flesh side.

Belts that are dry and slip can be made to adhere more closely by putting on a little neats-foot or castor oil. The first is considered the best to use. Do not put rosin on the belts as it causes them to crack by making them hard.

Where narrow belts are to run over small pulleys.—15 feet is a good average—the belt having a sag of 1½ to 2 inches.

For larger belts, working on larger pulleys, a distance of 20 to 25 feet, with a sag of 2½ to 4 inches.

For main belts working on very large pulleys, the distance should be 25 to 30 feet, with a sag of 4 to 5 inches.

Rules for Calculating the Speed of Drums and Pulleys.

The diameter of the driver being given, to find its number of revolutions.

Rule:—Multiply the diameter of the driver by number of its revolutions, and divide the product by the diameter of the driven, the quotient will be the number of revolutions of the driven.

The diameter and revolutions of the driver being given, to find the diameter of the driven that shall make any given number of revolutions in the same time.

Rule:—Multiply the diameter of the driver by its number of revolutions and divide the product by the number of revolutions of the driven; the quotient will be its diameter.

To ascertain the size of the driver.

Rule:—Multiply the diameter of the driven by the number of revolutions you wish to make, and divide the product by the revolutions of the driver; the quotient will be the diameter of the driver.

N. B.—In ordering Pulleys, be careful to give the exact size of the Shaft on which they are to go, also state how you wish them finished on the face; *Flat* face for shifting belt, *Rounding* for non-shifting belt.

The following table shows the velocity of belts; the column marked "Revolution Shaft" shows the number of revolutions which the line or driven shaft is supposed to make per minute; the column marked "Diameter of Drum" shows the diameter of the drum on the line or driven shaft.

Revolution Shaft	Diameter of Drum.								
	2	2½	3	3½	4	4½	5	5½	6
	Number of Feet.								
100	628	785	942	1099	1256	1413	1570	1727	1884
110	690	863	1036	1208	1381	1554	1727	1899	2072
120	753	942	1130	1318	1507	1695	1884	2072	2260
130	816	1020	1224	1428	1632	1836	2041	2245	2449
140	879	1099	1318	1538	1758	1978	2198	2417	2637
150	942	1177	1413	1648	1884	2119	2355	2590	2826
160	1004	1256	1507	1758	2009	2260	2512	2763	3014
170	1067	1334	1601	1868	2135	2402	2669	2935	3202
180	1130	1413	1695	1978	2260	2543	2826	3108	3391
190	1193	1491	1789	2088	2386	2684	2983	3281	3579
200	1256	1570	1884	2193	2512	2826	3140	3454	3768

Example 1.—The line shaft is required to make 120 turns per minute, and it is desired to have the belt run 1800 feet per minute; required, the diameter of the driven drum. Find 120 in the column marked "Revolution Shaft;" opposite to this number in the table find 1800 or the nearest to it, which is 1884 feet; over this number in the column marked "Diameter of Drum," will be found 5 feet, the diameter of the drum.

Example 2.—The line shaft makes 100 turns per minute, the diameter of the driven drum is 4 feet; required, the number of feet the belt moves a minute. Find 100 in the column marked "Revolution Shaft," opposite to the number in the table, and under 4 in the column marked "Diameter of Drum," will be found 1256 feet.

The following table shows the width of the counter-belt that drives the counter-shaft, from which any number of

large size board-planing machines from one to four may be driven. The columns marked "Pulleys," shows the diameter of the smallest of the two pulleys on which the counter-belt runs; the columns marked "No. Machines," shows the number of machines to be driven.

Pulleys.	No. Machines.				Pulleys.	No. Machines.			
	1	2	3	4		1	2	3	4
	Width of Belt.					Width of Belt.			
12	7½	15	22½	30	26	3½	7	10¼	13¾
14	6½	13	19½	26	28	3¼	6½	9½	12¾
16	5½	11¼	16¾	22½	30	3	6	9	12
18	5	10	15	20	32		5½	8½	11¼
20	4½	9	13½	18	34		5¼	8	10½
22	4	8¼	12¼	16½	36		5	7½	10
24	3¾	7½	11¼	15					

EXAMPLE—Required the width of a belt to drive two board-planing machines, the diameter of the smallest pulley being 20 inches. Find 20 in the column marked "Pulley," opposite to this number in the table, and under 2 in the column marked "No. Machines," will be found 9 inches, the required width of a counter-belt that drives a counter-shaft which drives two large size board-planing machines.

Table of Power Transmitted by Wire Ropes.

Diam. of wh'el in feet.	No. of Rope.	Diam of Rope.	Revolutions per Minute.			
			80	100	120	140
			HORSE-POWER.			
4	24	$\frac{3}{8}$	3.3	4.1	5.0	5.8
5	23	$\frac{7}{16}$	6.9	8.6	10.3	12.1
6	22	$\frac{15}{32}$	10.7	13.4	16.1	18.7
7	22	$\frac{15}{32}$	16.9	21.1	25.3	29.6
8	21	$\frac{1}{2}$	22.0	27.5	33.0	38.5
9	20	$\frac{5}{8}$	40.0	41.5	50.0	51.9
10	19	$\frac{11}{16}$	55.0	58.4	73.0	82.5
11	18	$\frac{11}{16}$	64.9	75.5	81.0	97.3
12	17	$\frac{3}{4}$	93.4	99.3	116.7	124.1
13	17	$\frac{3}{4}$	112.0	140.0	168.0	
14	16	$\frac{7}{8}$	141.0	148.0	185.0	
15	16	$\frac{7}{8}$	217.0	259.0	300.0	

WEIGHTS of MATERIALS.

TABLE Showing Standard Sizes of AMERICAN and ENGLISH WIRE GAUGES In Parts of an Inch.

No. of Gauge.	Amer'n Gauge in Decimals.	Amer'n Gauge in Fract'ns.	English Gauge in Decimals.	English Gauge in Fract'ns.	No. of Gauge.	Amer'n Gauge in Decimals.	Amer'n Gauge in Fract'ns.	English Gauge in Decimals.	Eng. Ga'g'e in Fract.
	Inch	Inch	Inch	Inch		Inch	Inch	In.	In.
0000	.46	15-32	.454	15-32	18	.0403		.049	
000	.4096	13-32	.425	27-64	19	.0359		.042	3-64
00	.3648	23-64	.380	3-8	20	.0319	1-32	.035	
0	.3248	21-64	.340	11-32	21	.0284		.032	1-32
1	.2893	19-64	.300	19-64	22	.0253		.028	
2	.2576	1-4	.284	9-32	23	.0225		.025	
3	.2294	15-64	.259	1-4	24	.0201		.022	
4	.2043	13-64	.238	15-16	25	.0179	1-64	.02	
5	.1819	3-16	.220		26	.016		.018	1-64
6	.1620	5-32	.203	13-64	27	.0142		.016	
7	.1443	9-64	.180	3-16	28	.0126		.014	
8	.1285	1-8	.165	5-32	29	.0112		.012	
9	.1144		.148	9-64	30	.012		.01	
10	.1019	7-64	.134		31	.01		.009	
11	.0907	3-32	.120	1-8	32	.0079		.008	
12	.0808		.109	7-64	33	.007		.007	
13	.0719	5-64	.095	3-32	34	.0063		.005	
14	.0641		.083		35	.0056		.004	
15	.057		.072	5-64	36	.005			
16	.0508		.065		37				
17	.0452	3-64	.058	1-16	38				

Table showing the thickness and weight of Galvanized Sheet Iron by American gauge.

Wire Gauge.	Thick-ness.	Weight per Sq Foot.	Wire Gauge.	Thick-ness.	Weight per Sq Foot.
No.	Ins.	oz.	No.	Ins.	oz.
30	.012	10	22	.0253	21
29	.0112	11	21	.0284	24
28	.0126	12	20	.0319	28
27	.0142	14	19	.0359	33
26	.016	15	18	.0403	37
25	.0179	16	17	.0452	43
24	.0201	17	16	.0508	48
23	.0225	19	14	.0641	60

Table showing weight of Lead Pipe required for a given head (or fall) of water.

Head or fall in feet.	Pressure per sq. inch.	Calibre in Inches.						
		3/8	1/2	5/8	3/4	1	1 1/4	1 1/2
		Weight per foot in lbs.						
20	10	.38	.63	.87	1.	1.5	2.	3.
30	15	.5	.75	1.38	1.5	2.	2.5	3.5
40	20	.68	1.	1.75	2.	2.5	3.	4.
50	25	.75	1.25	2.	2.5	3.	4.	5.
75	38	1.	1.63	2.38	3.38	4.	5.	6.
100	50	1.25	2.	3.	4.0	5.	7.	10.
150	75	1.38	2.5	3.5	4.5	6.	9.	12.
200	100	1.5	3.	4.	5.	7.	12.	15.

The above weights of pipe are of sufficient strength to permit the water to be shut off, or stopped. When the water is permitted to run constantly, two-thirds of the above weight will answer.

LEAD PIPE. Weight per lineal foot. (AMERICAN).

Calculated inside Diam.	Thickness in Inches.							
	1/16	1/8	3/16	1/4	3/8	1/2	5/8	3/4
	Weight in Pounds.							
Ins.								
3/8	.427	.97	1.65	2.44	4.38			
1/2	.548	1.21	2.01	2.93	5.11	7.79		
5/8	.670	1.46	2.38	3.42	5.85	8.77	12.2	
3/4	.791	1.70	2.74	3.90	6.58	9.75	13.4	17.6
7/8	.911	1.95	3.11	4.39	7.31	10.7	14.6	19.1
1	1.03	2.19	3.47	4.88	8.04	11.7	15.8	20.5
1 1/4	1.28	2.69	4.21	5.85	9.5	13 7	18.3	23.4
1 1/2	1.52	3.18	4.94	6.83	11.	15.6	20.7	26.3
1 3/4	1.76	3.67	5.67	7.81	12.4	17.6	23.2	29.3
2	2.01	4.16	6.40	8.78	13.9	19.5	25.6	32.2
2 1/4	2.25	4.65	7.13	9.76	15.4	21.5	28.1	35.1
2 1/2	2.49	5.14	7.86	10.7	16.8	23.4	30.5	38.0
2 3/4	2.73	5.63	8.59	11.7	18.3	25.4	32.9	41.
3	2.98	6.12	9.32	12.7	19.7	27.3	35.4	43.9
3 1/2	3.46	7.10	10.8	14.6	22.7	31.3	40.3	49.7
4	3.95	8.08	12.2	16.6	25.6	35.2	45.2	55.6

Joints to lead pipes require 1 lb. of solder for every inch diameter.

Weight of Lead Pipe.
(ENGLISH.)

	Common.	Medium.	Strong.
½ in. bore w'g't per 15 ft. length.	lbs.	lbs.	lbs.
	15	18	22
⅝ " "	18	22	47
¾ " "	24	32	42
1 " "	42	56	64
1¼ " 12	42	52	63
1½ " "	50	72	84
1¾ " "	70	81	90
2 " "	84	96	112

WEIGHT and DIMENSIONS of LEADEN BALLS.
Number of balls in a pound from 1 5-16 ths to .237 of an inch in Diameter.

Diameter in Inches.	No.	Diameter in Inches.	No.	Diameter in Inches.	No.
1.67	1	.57	25	.301	170
1.326	2	.537	30	.295	180
1.157	3	.51	35	.29	190
1.051	4	.505	36	.285	200
.977	5	.488	40	.281	210
.919	6	.469	45	.276	220
.873	7	.453	50	.272	230
.835	8	.426	60	.268	240
.802	9	.407	70	.265	250
.775	10	.395	75	.262	260
.75	11	.388	80	.259	270
.73	12	.375	88	.256	280
.71	13	.372	90	.252	290
.693	14	.359	100	.249	300
.677	15	.348	110	.247	310
.662	16	.338	120	.244	320
.65	17	.329	130	.242	330
.637	18	.321	140	.239	340
.625	19	.314	150	.237	350
.615	20	.307	160		

Thickness and weight per square foot of Window Glass.

No.	Thickness.	Weight.	No.	Thickness.	Weight.
	Ins.	oz.		Ins.	oz.
12	.059	12	21	.1	21
13	.063	13	24	.111	24
15	.071	15	26	.125	26
16	.077	16	32	.154	32
17	.083	17	36	.167	36
19	.091	19	42	.2	42

Diameter and number of Pellets in an ounce of shot. (American Standard).

Number.	Diam. in Inches.	Pellets.	Number.	Diam. in Inches.	Pellets.
T T	.21	32	5	.12	149
T	.20	38	6	.11	209
BBB	.19	44	7	.10	278
BB	.18	49	8	.09	375
B	.17	58	9	.08	560
1	.16	69	10	.07	822
2	.15	82	11	.06	982
3	.14	98	12	.05	1778
4	.13	121			

Table Showing Weight per Foot of Sheet and Bar Brass.

Thickness, or Diameter, or Side, inches.	Sheets, Square foot.	Square Bars, 1 foot long.	Round Bars, 1 foot long.	Thickness, or Diameter, or Side, inches.	Sheets, Square foot.	Square Bars, 1 foot long.	Round Bars, 1 foot long.
1-16	2.7	.015	.011	1-16	45.95	4.08	3.20
1/8	5.41	.055	.045	1/8	48.68	4.55	3.57
3-16	8.12	.125	.1	3-16	51.4	5.08	3.97
1/4	10.76	.225	.175	1/4	54.18	5.65	4.41
5-16	13.48	.350	.275	5-16	56.85	6.22	4.86
3/8	16.25	.51	.395	3/8	59.55	6.81	5.35
7-16	19.	.69	.54	7-16	62.25	7.45	5.85
1/2	21.65	.905	.71	1/2	65.	8.13	6.37
9-16	24.3	1.15	.9	9-16	67.75	8.83	6.92
5/8	27.12	1.4	1.1	5/8	70.35	9.55	7.48
11-16	29.77	1.72	1.35	11-16	73.	10.27	8.05
3/4	32.46	2.05	1.06	3/4	75.86	11.	8.65
13-16	35.18	2.4	1.85	13-16	78.55	11.82	9.29
7/8	37.85	2.75	2.15	7/8	81.25	12.68	9.95
15-16	40.55	3.15	2.48	15-16	84.	13.5	10.58
1	43.29	3.65	2.89	1	86.75	14.35	11.25

WEIGHT of ROUND BOLT COPPER, PER FOOT.

Diam.	Weight per foot in length.	Diam.	Weight per foot in length.
3/8 inch.	.424 lbs.	1 1/4 inch.	4.71 lbs.
1/2 "	.755 "	1 3/8 "	5.71 "
5/8 "	1.17 "	1 1/2 "	6.79 "
3/4 "	1.69 "	1 5/8 "	7.94 "
7/8 "	2.31 "	1 3/4 "	9.21 "
1 "	3.02 "	1 7/8 "	10.61 "
1 1/8 "	3.82 "	2 "	12.08 "

Plate or Sheet Iron, Brass, Copper and Lead. Weight of a Superficial Foot in Pounds.

(AVOIRDUPOIS).

Thickness in Parts of an Inch.

Inch.	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8
Iron in lbs.	2.5	5.	7.5	10.	12.5	15.	17.5	20.	25.	34.	35.
Brass " "	2.7	5.5	8.2	10.9	13.6	16.3	19.	21.8	27.1	32.5	37.9
Cop'er" "	2.9	5.8	8.7	11.6	14.5	17.4	20.3	23.2	28.9	34.7	40.4
Lead " "	3.7	7.4	11.1	14.8	18.5	22.2	25.9	29.6	37.	44.4	57.8

Thickness by the Birmingham wire-gauge, and in deci'als.

Wire Gauge.	0000.	000.	00.	0	1	2	3
Thickness in decimals of an inch.	.454	.425	.380	.340	.300	.284	.259
Iron in lbs.	18.99	17.78	15.89	14.22	12.5	12.	11.
Brass" "	21.11	19.76	17.67	15.81	13.75	13.2	12.1
Copper "	21.61	20.53	18.37	16.43	14.5	13.9	12.75

Thickness by the Birmingham wire-gauge, and in deci'als.

Wire Gauge.	4	5	6	7	8	9	10
Thickness in decimals of an inch.	.238	.220	.203	.180	.165	.148	.134
Iron in lbs.	10.	8.74	8.12	7.5	6.86	6.24	5.62
Brass" "	11.	9.61	8.93	8.25	7.54	6.86	6.18
Copper "	11.6	10.1	9.4	8.7	7.9	7.2	6.5

Thickness by the Birmingham wire-gauge, and in deci'als.

Wire Gauge.	11	12	13	14	15	16	17
Thick.in dec. of an inch.	.120	.109	.095	.083	.072	.065	.058
Iron in lbs.	5.	4.38	3.75	3.12	2.82	2.5	2.18
Brass. "	5.5	4.81	4.12	3.43	3.1	2.75	2.4
Copper."	5.8	5.08	4.34	3.6	3.27	2.9	2.52

Thickness by the Birmingham wire-gauge, and in deci'als.

Wire Gauge.	18	19	20	21	22	23	24
Thick. in dec. of an inch.	.049	.042	.035	.032	.028	.025	.022
Iron in lbs.	1.86	1.7	1.54	1.4	1.25	1.12	1.
Brass. "	2.04	1.87	1.69	1.54	1.37	1.23	1.1
Copper. "	2.15	1.97	1.78	1.62	1.45	1.3	1.16

Cast-Iron Pipes, Hollow Columns, or Cylinders, Weight per lineal foot.

Diam. of Bore.	Thickness in Inches.								
	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4
Ins.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	3.06	5.06	7.36	9.97	12.89	16.11	19.63		
1 1/4	3.68	5.98	8.59	11.51	14.73	18.25	22.09		
1 1/2	4.29	6.9	9.82	13.04	16.56	20.4	24.54		
1 3/4	4.91	7.83	11.05	14.57	18.41	22.5	27.		
2	5.53	8.75	12.25	16.11	20.25	24.7	29.45		
2 1/4	6.14	9.66	13.5	17.64	22.09	26.84	31.85		
2 1/2	6.74	10.58	14.72	19.17	23.92	28.93	34.36		
2 3/4	7.36	11.5	15.91	20.7	25.71	31.14	36.81		
3	7.98	12.43	17.18	22.19	27.62	33.29	39.25	45.56	52.2
3 1/4	8.59	13.34	18.35	23.78	29.45	35.44	41.72	48.32	55.22
3 1/2	9.2	14.21	19.64	25.31	31.3	37.58	44.18	51.08	58.29
3 3/4	9.76	15.19	20.86	26.85	33.13	39.73	46.63	53.84	61.36
4	10.44	16.11	22.1	28.38	34.98	41.88	49.	56.61	64.25
4 1/4	11.1	17.08	23.37	29.97	36.87	44.03	51.6	59.42	67.45
4 1/2	11.66	17.94	24.54	31.44	38.65	46.17	53.99	62.12	70.56
4 3/4	12.27	18.87	25.77	32.98	40.5	48.32	56.45	64.89	73.63
5	12.88	19.78	27.	34.54	42.25	50.46	58.9	67.64	76.25
5 1/4	13.5	20.71	28.23	36.05	44.18	52.62	61.36	70.41	79.77
5 1/2	14.11	21.63	29.45	37.58	46.02	54.76	63.81	73.17	82.84
5 3/4	14.73	22.55	30.68	39.12	47.86	56.91	66.27	75.94	85.91
6	15.34	23.47	31.9	40.65	49.5	59.06	68.5	78.7	89.
7	17.79	27.15	36.8	46.79	56.84	67.65	78.5	89.74	101.25
8	20.02	30.83	41.7	52.92	64.42	76.23	88.25	100.78	114.
9	22.71	34.52	46.5	59.07	71.5	84.84	99.5	111.84	126.
10	25.16	38.2	51.5	65.2	79.16	93.42	108.	122.87	138.
11	27.62	41.88	56.25	71.33	86.5	102.01	117.5	133.92	150.3
12	30.06	45.55	61.	77.46	93.6	110.6	127.25	144.96	163.
14				90.6	109.6	129.	148.8	168.7	189.
16					124.5	146.4	168.6	181.0	213.8
18					139.4	163.7	188.4	213.3	238.5
20					.....	181.1	208.2	235.6	263.3
24					182.		247.9	280.2	312.9
28					213.		286.		360.
30					227.		305.		384.
34					257.		345.		443.

Weight of Cast-Iron, Brass, Copper and Lead Balls from 1 inch to 12 inches in diameter.

Diam.	Cast-Iron.	Br'ss.	Copper.	Le'd	Diam	Cast-Iron.	Br'ss.	Copper.	Le'd
Ins.	lbs.	lbs.	lbs.	lbs.	Ins.	lbs.	lbs.	lbs.	lbs.
1	.136	.158	.166	.214	7	47.76	54.5	57.1	73.7
1 1/2	.46	.537	.56	.727	7 1/2	57.52	67.11	70.0	90.
2	1.09	1.25	1.3	1.7	8	69.81	81.4	85.2	110.1

(TABLE CONTINUED).

Diam.	Cast-Iron.	Br'ss.	Cop-per.	Le'd	Diam	Cast-Iron.	Br'ss.	Cop-per.	Le'd
Ins.	lbs.	lbs.	lbs.	lbs.	Ins.	lbs.	lbs.	lbs.	lbs.
2½	2.13	2.50	2.60	3.35	8½	83.73	100.0	102.3	132.3
3	3.68	4.3	4.5	5.8	9	99.4	115.9	121.3	156.7
3¼	5.84	6.82	7.14	9.23	9½	116.9	136.4	143.0	184.7
4	8.72	10.2	10.7	13.8	10	136.35	159.0	166.4	215.0
4½	12.42	14.5	15.25	19.6	10½	157.84	184.0	193.0	250.0
5	17.04	19.9	20.8	26.9	11	181.48	211.8	221.8	286.7
5½	22.68	26.47	27.74	36.0	11½	207.37	242.0	253.5	327.7
6	29.45	34.3	35.9	46.4	12	235.62	275.0	288.1	372.3
6½	37.44	43.67	45.76	59.13					

Weight of Parallel Angle Iron of equal sides, and Parallel T Iron, equal depth and width.

Parallel Angle Iron. *Parallel T Iron.*

Length of sides in Ins.	Uniform thickn'ss Through-out.	W'g't of 1 lineal ft. in lbs and dec. parts	Width of top table and total depth.	Uniform thickn'ss through-out.	W'g't of 1 lineal ft. in lbs and dec. parts
Ins.	Ins.		Ins.	Ins.	
3	⅜	8.0	6	½	18.25
2¾	⅜	7.0	5	7-16	13.75
2⅜	⅜	5.75	4	⅜	9.75
2¼	5/16	4.5	3½	⅜	8.5
2	¼ full	3.75	3	⅜	7.5
2¾	¼	3.0	2½	5-16	4.63
2½	¼	2.5	2¼	5-16	4.5
1⅜	No. 6 w.g.	1.75	2	5-16	3.75
1¼	8	1.5	1¾	¼	3.0
1⅛	9	1.25	1½	¼	2.25
1	10	1.0	1¼	¼	1.75
⅞	10	.875	1	3-16	1.0
¾	11	.625	⅞	⅛	.73
⅝	11	.563	¾	⅛	.63
½	12	.5			

Table Showing Number of Rivets in One Hundred Pounds.

Length in Ins.	Diameter in Inches.				Length in Ins.	Diameter in Inches.			
	½	⅝	11/16	¾		½	⅝	11/16	¾
¾	1092	665			3¼	433	267	212	180
⅞	1027	597			3½	413	248	201	169
1	940	538	450		3¾	395	241	192	160
1⅛	840	512	415		4		230	184	158
1¼	797	487	389	356	4¼		220	177	150
1⅜	760	460	370	329	4½		210	171	146
1½	730	440	357	280	4¾		200	166	138
1⅝	711	420	340	271	5		190	161	135

Table Showing No. of Rivets in 100 Pounds. (CONTINUED).

Length in Ins.	Diameter in Inches.				Length in Ins.	Diameter in Inches.			
	1/2	5/8	11/16	3/4		1/2	5/8	11/16	3/4
1¾	693	390	325	262	5¼		180	156	130
1⅞	648	375	312	257	5½		172	151	124
2	608	360	297	243	5¾		164	145	120
2⅛	573	354	289	237	6		157	140	115
2¼	555	347	280	232	6¼		150	138	111
2½	525	335	260	220	6½		146	134	107
2¾	500	312	242	208	6¾		143	129	104
3	460	290	224	197	7		140	125	100

Weights of Taper Angle Iron, of equal Sides, and Taper T Iron.

Taper Angle Iron, of equal Sides.				Taper T Iron.					
Length of sides in Ins.	Thickness of Edges.	Thickness of Root.	W'g't of 1 lineal ft. in lbs. & dec. parts.	Width of top table in Ins.	Total depth in inches.	Thickness of top table at edges.	Uniform thickness of rib.	Thickness of top table at root.	W'g't of 1 lineal ft. in lbs. & dec. parts.
Ins.	Ins.	Ins.		Ins	Ins	Ins	Ins	Ins	
4	1/2	5/8	14.0	3	3¼	3/8	7-16	1/2	8.0
3	1/2	5/8	10.37	3	2⅝	3/8	1/2	7-16	8.0
2¾	7-16	9-16	8.25	3	3	5-16	5-16	7-16	5.25
2½	3/8	1/2	6.5	2½	2½	1/2	1/2‡	5/8	6.5
2¼	5-16‡	7-16	5.	2	1½	5-16	3/8	5/8‡	3.5
2	1/4 ‡	5-16‡	5.87	2	1½	1/4	1/4	5-16	2.87
1¾	1/4	5-16	3.25						
1½*	1/4 *	5-16*	2.62						

* *Bare.* ‡ *Full.*

Number of Nails in a Pound.

Title.	Size.	No. per lb.	Title.	Size.	No. per lb.
2 penny fine.	1⅛ In.	760 nails.	16 pen. f	3½ In	32 nails.
3 "	1¼ "	480 "	20	4 "	24 "
4 "	1½ "	300 "	30	4½ "	18 "
5 "	1¾ "	200 "	40	5 "	14 "
6 "	2 "	160 "	50	5½ "	12 "
7 "	2¼ "	128 "	60	6 "	10 "
8 "	2½ "	92 "	6 fence	2 "	80 "
9 "	2¾ "	72 "	8 "	2½ "	50 "
10 "	3 "	60 "	10 "	3 "	34 "
12 "	3¼ "	44 "	12 "	3¼ "	29 "

Number of Tacks in a Pound.

Title.	Length.	No. per lb.	Title.	Length.	No. per lb.
1 oz.	1/8 In.	16.000	10 oz.	11-16	1.600
1½	3-16	10.666	12	¾	1.333
2	¼	8.000	14	13-16	1.143
2½	5-16	6.400	16	⅞	1.000
3	⅜	5.333	18	15-16	.888
4	7-16	4.000	20	1	.800
6	9-16	2.666	22	1 1-16	.727
8	⅝	2.000	24	1 ⅛	.666

Table Showing Weight of 100 feet of Iron, Steel, Copper and Brass Wire. (*English and American Gauges*).

American and Eng. No. of gauge	American Gauge. Thick's in Dec.	American Gauge. Wire per 100 lineal feet. I.	S.	C.	B.	Birmingham Gauge. Thick's in Dec.	Birmingham Gauge. Wire per 100 lineal feet. I.	S.	C.	B.
	Ins	lbs.	lbs.	lbs.	lbs.	Ins	lbs.	lbs.	lbs.	lbs.
0000	.46	56.07	56.60	64.05	60.51	.454	54.62	55.13	62.39	58.93
000	.409	44.46	44.88	50.79	47.99	.425	47.86	48.32	54.67	51.64
00	.364	35.26	35.59	40.28	38.06	.38	38.27	38.63	43.71	41.28
0	.324	27.96	28.23	31.94	30.18	.34	30.63	30.92	34.99	33.05
1	.289	22.17	22.38	25.33	23.93	.3	23.85	24.07	27.24	25.73
2	.257	17.58	17.75	20.09	18.98	.284	21.37	21.57	24.41	23.06
3	.229	13.94	14.07	15.93	15.05	.259	17.78	17.94	20.03	19.18
4	.204	11.06	11.16	12.63	11.93	.238	15.01	15.15	17.15	16.19
5	.181	8.77	8.85	10.02	9.46	.22	12.82	12.95	14.65	13.84
6	.162	6.95	7.02	7.94	7.50	.203	10.92	11.02	12.47	11.78
7	.144	5.51	5.56	6.30	5.95	.18	8.58	8.66	9.80	9.26
8	.128	4.37	4.41	4.99	4.72	.165	7.21	7.28	8.24	7.78
9	.114	3.46	3.50	3.96	3.74	.148	5.80	5.85	6.63	6.26
10	.101	2.75	2.77	3.14	2.96	.134	4.75	4.80	5.43	5.13
11	.090	2.18	2.20	2.49	2.35	.12	3.81	3.85	4.35	4.11
12	.080	1.73	1.74	1.97	1.86	.109	3.15	3.18	3.59	3.39
13	.071	1.37	1.38	1.56	1.48	.095	2.39	2.41	2.73	2.58
14	.064	1.08	1.09	1.24	1.17	.083	1.82	1.84	2.08	1.96
15	.057	.86	.87	.98	.93	.072	1.37	1.38	1.57	1.48
16	.050	.68	.69	.78	.75	.065	1.12	1.13	1.28	1.21
17	.045	.54	.54	.61	.58	.058	.89	.90	1.08	.96
18	.040	.43	.43	.49	.46	.049	.63	.64	.72	.68
19	.035	.34	.34	.38	.36	.042	.46	.47	.53	.51
20	.031	.27	.27	.30	.29	.035	.32	.33	.37	.35
21	.028	.21	.21	.24	.23	.032	.27	.27	.31	.29
22	.025	.17	.17	.19	.18	.028	.20	.21	.23	.22
23	.022	.13	.13	.15	.14	.025	.16	.16	.19	.18
24	.020	.10	.10	.12	.11	.022	.12	.13	.15	.14
25	.017	.08	.08	.09	.09	.02	.10	.10	.12	.11
26	.015	.06	.06	.07	.07	.018	.08	.08	.09	.09

Table Showing Weight of Wrought Iron, Steel, Copper and Brass. (*American and English Gauges*).

American and Eng. No. of gauge	American Gauge.					Birmingham Gauge.				
	Thick's in Dec.	Plates per Sq. foot.				Thick's in Dec.	Plates per Sq. fooot			
		I.	S.	C.	B.		I.	S.	C.	B.
	Ins	lbs.	lbs.	lbs.	lbs.	Ins	lbs.	lbs.	lbs.	lbs.
0000	.46	18.45	18.70	20.83	19.68	.454	18.21	18.45	20.56	19.43
000	.409	16.43	16.65	18.55	17.53	.425	17.05	17.28	19.25	18.19
00	.364	14.63	14.83	16.52	15.61	.38	15.24	15.45	17.21	16.26
0	.324	13.03	13.20	14.71	13.90	.34	13.64	13.82	15.40	14.55
1	.289	11.60	11.76	13.10	12.38	.3	12.03	12.19	13.59	12.84
2	.257	10.33	10.47	11.67	11.02	.284	11.39	11.54	12.86	12.15
3	.229	9.20	9.32	10.39	9.81	.259	10.39	10.53	11.73	11.08
4	.204	8.19	8.30	9.25	8.74	.238	9.54	9.67	10.78	10.18
5	.181	7.30	7.39	8.24	7.78	.22	8.82	8.94	9.96	9.41
6	.162	6.50	6.58	7.33	6.93	.203	8.14	8.25	9.19	8.68
7	.144	5.78	5.86	6.53	6.17	.18	7.22	7.31	8.15	7.70
8	.128	5.15	5.22	5.82	5.49	.165	6.62	6.70	7.47	7.06
9	.114	4.59	4.65	5.18	4.89	.148	5.93	6.01	6.70	6.33
10	.101	4.08	4.14	4.61	4.36	.134	5.37	5.44	6.07	5.73
11	.090	3.64	3.68	4.11	3.88	.12	4.81	4.87	5.43	5.13
12	.080	3.24	3.28	3.66	3.45	.109	4.37	4.83	4.93	4.66
13	.071	2.88	2.92	3.25	3.07	.095	3.81	3.86	4.30	4.06
14	.064	2.57	2.60	2.90	2.74	.083	3.33	3.37	3.75	3.55
15	.057	2.28	2.32	2.58	2.44	.072	2.88	2.92	3.26	3.08
16	.050	2.03	2.06	2.30	2.17	.065	2.60	2.64	2.94	2.78
17	.045	1.81	1.84	2.05	1.93	.058	2.32	2.35	2.62	2.48
18	.040	1.61	1.63	1.82	1.72	.049	1.96	1.99	2.21	2.09
19	.035	1.44	1.45	1.62	1.53	.042	1.68	1.70	1.90	1.79
20	.031	1.28	1.29	1.44	1.36	.035	1.40	1.42	1.58	1.49
21	.028	1.14	1.15	1.28	1.21	.032	1.28	1.30	1.44	1.36
22	.025	1.01	1.03	1.14	1.08	.028	1.12	1.13	1.26	1.19
23	.022	.90	.91	1.02	.96	.025	1.00	1.01	1.13	1.07
24	.020	.80	.81	.91	.86	.022	.88	.89	.99	.94
25	.017	.71	.72	.81	.76	.02	.80	.81	.90	.85
26	.015	.63	.64	.72	.68	.018	.72	.73	.81	.77

Weight of a lineal foot of Square and Round Malleable Bar Iron from 1-4 inch to 12 inches in diameter.

(Avoirdupois Pounds).

Size Inches.	1/4	5-16	3/8	7-16	1/2	9-16	5/8	11-16	3/4
Sq. Rolled bar Iron	.208	.325	.468	.638	.833	1.05	1.30	1.57	1.87
Round " "	.163	.255	.368	.501	.654	.821	1.02	1.23	1.47

Size Inches.	13/16	7/8	15/16	1	1 1/16	1 1/8	1 3/16	1 1/4	1 5/16
Sq. Rolled Iron.	2.00	2.55	2.92	3.33	3.76	4.21	4.70	5.20	5.74
Round " "	1.72	2.0	2.30	2.61	2.95	3.31	3.69	4.39	4.51

Square and Round Malleable Bar Iron. (Continued).

Size Ins.	$1\frac{3}{16}$	$1\frac{7}{16}$	$1\frac{1}{2}$	$1\frac{9}{16}$	$1\frac{5}{8}$	$1\frac{11}{16}$	$1\frac{3}{4}$	$1\frac{13}{16}$	$1\frac{7}{8}$
Sq.R.I.bar	6.30	6.88	7.50	8.15	8.80	9.50	10.20	10.69	11.75
Round "	4.95	5.40	5.89	6.40	6.91	7.46	8.01	8.60	9.20
	$1\frac{15}{16}$	2	$2\frac{1}{8}$	$2\frac{1}{4}$	$2\frac{3}{8}$	$2\frac{1}{2}$	$2\frac{5}{8}$	$2\frac{3}{4}$	$2\frac{7}{8}$
Do	12.52	13.33	15.05	16.87	18.80	20.80	29.96	25.20	27.55
	9.83	10.47	11.82	13.25	14.76	16.36	18.03	19.79	21.63
	3	$3\frac{1}{8}$	$3\frac{1}{4}$	$3\frac{3}{8}$	$3\frac{1}{2}$	$3\frac{5}{8}$	$3\frac{3}{4}$	$3\frac{7}{8}$	4
Do	30.	32.55	35.20	37.96	40.80	43.80	46.87	50.05	53.33
	23.56	25.56	27.65	29.82	32.07	34.40	36.81	39.31	41.81
	$4\frac{1}{8}$	$4\frac{1}{4}$	$4\frac{3}{8}$	$4\frac{1}{2}$	$4\frac{5}{8}$	$4\frac{3}{4}$	$4\frac{7}{8}$	5	$5\frac{1}{4}$
Do	56.71	60.20	63.80	67.50	71.30	75.20	79.21	83.33	93.2
	44.54	47.28	50.11	53.01	56.	59.06	62.21	65.45	73.2
	$5\frac{1}{2}$	$5\frac{3}{4}$	6	$6\frac{1}{4}$	$6\frac{1}{2}$	$6\frac{3}{4}$	7	$7\frac{1}{4}$	$7\frac{1}{2}$
Do	102.2	111.8	127.	132.0	142.8	154.0	161.6	177.7	190.1
	80.3	87.8	95.6	103.6	112.2	121.0	130.0	139.5	149.3
	8	$8\frac{1}{2}$	9	$9\frac{1}{2}$	10	$10\frac{1}{2}$	11	$11\frac{1}{2}$	12
Do	216.3	244.2	273.8	305.1	337.9	372.7	409.0	447.0	486.7
	169.9	191.8	215.0	239.6	266.3	292.7	321.2	351.1	382.2

Weight of 9 feet length, of flanged Cast-Iron Pipes of various diameters.

Diameter of Bore.	Thickn'ss of Metal.	Diameter of Flange	Thickn'ss of Flange.	Diameter of Cir. thr-o'gh hole	Diam. of Holes.	No. of Holes	Weight.
Ins.	Ins.	Ins.	Ins.	Ins.	Ins.		Cwt-qr-lb
2	$\frac{3}{8}$	$6\frac{1}{2}$	$\frac{9}{16}$	$4\frac{3}{4}$	$\frac{5}{8}$	4	0—3— 0
3	$\frac{3}{8}$	$7\frac{1}{2}$	$\frac{5}{8}$	6	$\frac{5}{8}$	4	1—0— 3
4	$\frac{1}{2}$	$9\frac{1}{2}$	$\frac{3}{4}$	$7\frac{3}{4}$	$\frac{3}{4}$	4	1—3— 5
5	$\frac{1}{2}$	$10\frac{1}{2}$	$\frac{7}{8}$	$8\frac{3}{4}$	$\frac{3}{4}$	4	2—1—12
6	$\frac{5}{8}$	12	$\frac{7}{8}$	10	$\frac{7}{8}$	4	3—2— 1
7	$\frac{5}{8}$	14	1	$11\frac{3}{4}$	$\frac{7}{8}$	6	4—3—17
8	$\frac{3}{4}$	15	1	$12\frac{3}{4}$	1	6	5—2— 9
9	$\frac{3}{4}$	$16\frac{1}{2}$	$1\frac{1}{16}$	$14\frac{1}{4}$	1	6	6—1—12
10	$\frac{3}{4}$	$17\frac{1}{2}$	$1\frac{1}{8}$	$15\frac{1}{2}$	1	6	7—0— 0
11	$\frac{7}{8}$	19	$1\frac{3}{16}$	$16\frac{3}{4}$	1	6	8—3—24
12	$\frac{7}{8}$	20	$1\frac{1}{4}$	$17\frac{3}{4}$	$1\frac{1}{8}$	6	9—3— 5
13	$\frac{7}{8}$	21	$1\frac{1}{4}$	$18\frac{3}{4}$	$1\frac{1}{8}$	6	10—2— 0
14	$\frac{7}{8}$	22	$1\frac{1}{4}$	$19\frac{3}{4}$	$1\frac{1}{8}$	8	11—0—26
15	$\frac{7}{8}$	23	$1\frac{1}{4}$	$20\frac{3}{4}$	$1\frac{1}{8}$	8	12—0—25
16	$\frac{7}{8}$	$24\frac{1}{2}$	$1\frac{5}{16}$	22	$1\frac{3}{4}$	8	12—3— 8
17	$\frac{7}{8}$	$25\frac{1}{2}$	$1\frac{5}{16}$	23	$1\frac{1}{4}$	8	13—2—17
18	1	$26\frac{1}{2}$	$1\frac{3}{8}$	24	$1\frac{1}{4}$	8	16—1—15
19	1	28	$1\frac{3}{8}$	25	$1\frac{3}{8}$	8	17—2—13
20	1	29	$1\frac{3}{8}$	26	$1\frac{3}{8}$	8	18—0—26

TABLE SHOWING WEIGHT OF 1 FOOT OF SEAMLESS DRAWN BRASS AND COPPER TUBING.

Outside Diameter.	Length Feet.	Brown & Sharpe's Gauge.	Weight per Ft.	
			Brass.	Copper.
		No.	lbs.	lbs.
3/8	12	17	.17	.17
1/2	12	16	.25	.25
5/8	12	16	.33	.35
3/4	12	15	.42	.46
13-16	12	15	.47	.51
7/8	12	15	.52	.57
15-16	12	15	.58	.62
1	12	14	.66	.69
1 1/8	12	14	.85	.89
1 1/4	12	13	.93	.97
1 3/8	12	12 1/2	1.20	1.25
1 1/2	12	12	1.35	1.40
1 5/8	12	11 1/2	1.55	1.60
1 3/4	12	11	1.70	1.76
1 13-16	12	11	1.82	1.88
1 7/8	12	11 & 10	1.95	2.01
1 15-16	12	"	2.	2.06
2	12	"	2.05	2.10
2 1/8	10	"	2.10	2.16
2 1/4	10	"	2.35	2.40
2 3/8	10	"	2.36	2.42
2 1/2	10	8 & 8 1/2	3.	3.10
2 5/8	10	"	3.67	3.75
2 3/4	10	"	3.75	3.90
3	10	"	3.92	4.05
3 1/4	10	"	4.18	4.30
3 1/2	10	"	4.50	4.63
4	10	"	5.40	5.56
5	10	"	6.75	6.95

WEIGHT OF A SQUARE FOOT OF CAST AND WROUGHT IRON, COPPER, LEAD, BRASS AND ZINC.

From 1-16 to 2 inches in Thickness.

Thickness.	Cast-Iron.	Wr'g't Iron.	Copper.	Lead.	Brass.	Zinc.
Ins.	lbs.	lbs.	lbs.	lbs.	lbs	lbs.
1-16	2.346	2.517	2.89	3.691	2.675	2.34
1/8	4.693	5.035	5.781	7.382	5.35	4.68
3-16	7.039	7.552	8.672	11.074	8.025	7.02
1/4	9.386	10.07	11.562	14.765	10.7	9.36

Weight of a Square Foot of Cast and Wrought Iron, Copper, Lead, Brass and Zinc. (Table Continued).

Thickness.	Cast-Iron.	Wr'g't Iron.	Copper.	Lead.	Brass.	Zinc.
Ins.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
5-16	11.733	12.588	14.453	18.456	13.375	11.07
3/8	14.079	15.106	17.344	22.148	16.05	14.04
7-16	16.426	17.623	20.234	25.839	18.725	16.34
1/2	18.773	20.141	23.125	29.53	21.4	18.72
9-16	21.119	22.659	26.016	33.222	24.075	
5/8	23.466	25.176	28.906	36.913	26.75	
11-16	25.812	27.694	31.797	40.604	29.425	
3/4	28.159	30.211	34.688	44.296	32.1	
13-16	30.505	32.729	37.578	47.987		
7/8	32.852	35.247	40.469	51.678		
15-16	35.199	37.764	43.359	55.37		
1	37.545	40.282	46.250	59.061		
1 1/8	42.238	45.317	52.031			
1 1/4	46.931	50.352	57.813			
1 3/8	51.625	55.387	63.594			
1 1/2	56.317	60.422	69.375			
1 5/8	61.011	65.458	75.156			
1 3/4	65.704	70.493	80.938			
1 7/8	70.397	75.528	86.719			
2	75.090	80.563	92.500			

Weight of a lineal foot of Flat Rolled Iron from 1-4 inch to 15-16 inch thick by 1 inch to 3 inches wide.

W'd'h of Iron.	Thickness in Inches.											
	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	.83	1.04	1.25	1.45	1.66	1.87	2.08	2.29	2.50	2.70	2.91	3.12
1 1/8	.93	1.17	1.40	1.64	1.87	2.10	2.34	2.57	2.81	3.04	3.28	3.51
1 1/4	1.04	1.30	1.56	1.82	2.08	2.34	2.60	2.86	3.12	3.38	3.64	3.90
1 3/8	1.14	1.43	1.71	2.	2.29	2.57	2.86	3.15	3.43	3.72	4.01	4.29
1 1/2	1.25	1.56	1.87	2.18	2.50	2.81	3.12	3.43	3.75	4.06	4.37	4.68
1 5/8	1.35	1.69	2.03	2.36	2.70	3.04	3.38	3.72	4.06	4.40	4.73	5.07
1 3/4	1.45	1.82	2.18	2.55	2.91	3.28	3.64	4.01	4.37	4.73	5.10	5.46
1 7/8	1.56	1.95	2.34	2.73	3.12	3.51	3.90	4.29	4.68	5.07	5.46	5.85
2	1.66	2.08	2.50	2.91	3.33	3.75	4.16	4.58	5.	5.41	5.83	6.25
2 1/8	1.77	2.21	2.65	3.09	2.54	3.98	4.42	4.86	5.31	5.75	6.19	6.64
2 1/4	1.87	2.34	2.81	3.28	3.75	4.21	4.68	5.15	5.62	6.09	6.56	7.03
2 3/8	1.97	2.47	2.96	3.46	3.95	4.45	4.94	5.44	5.93	6.43	6.92	7.42
2 1/2	2.08	2.60	3.12	3.64	4.16	4.68	5.20	5.72	6.25	6.77	7.29	7.81
2 5/8	2.18	2.73	3.28	3.82	4.37	4.92	5.46	6.01	6.56	7.10	7.65	8.20
2 3/4	2.29	2.86	3.43	4.01	4.58	5.15	5.72	6.30	6.87	7.44	8.02	8.59
2 7/8	2.39	2.99	3.59	4.19	4.79	5.39	5.98	6.58	7.18	7.78	8.38	8.98
3	2.50	3.14	3.75	4.37	5.	5.62	6.25	6.87	7.50	8.12	8.75	9.37

To ascertain the Weights of *larger sizes* take the *half* size of that required, and double it. Thus, required the weight of 4×½ in. refer to 2×½ in.=3.33×2=6.66 lbs.

Table showing the weight of water in pipes of various diameters, one foot in length.

Diam. in Ins.	Weight in lbs.	Diam. in Ins.	Weight in lbs.	Diam. in Ins.	Weight in lbs.	Diam. in Ins.	Weight in lbs.	Diam. in Ins.	Weight in lbs.
3	3	8¼	241½	14	663/4	19½	1291/2	30	3063/4
3¼	3½	8½	26	14¼	691/4	193/4	132	30½	3171/4
3½	4¼	9	271/2	14½	711/4	20	1361/2	31	3271/4
3¾	4¾	9¼	291/4	143/4	741/4	20½	1431/2	31½	3381/4
4	5½	9½	303/4	15	763/4	21	1501/4	32	349
4¼	6¼	9¾	321/2	15¼	791/4	21½	1571/2	32½	360
4½	7	10	34	15½	82	22	165	33	3711/4
4¾	7¾	10¼	351/2	153/4	841/2	22½	1721/2	33½	3821/2
5	8½	10½	371/2	16	871/4	23	1801/4	34	394
5¼	9¼	10¾	391/4	16¼	90	23½	1881/4	34½	4053/4
5½	10¼	11	411/4	16½	921/4	24	1961/4	35	4171/2
5¾	11¼	11¼	431/4	163/4	951/2	24½	2041/2	35½	4291/2
6	12¼	11½	45	17	981/2	25	213	36	4413/4
6¼	13¼	11¾	47	17¼	1012	25½	2211/2	36½	454
6½	14½	12	49	17½	1041/2	26	2301/4	37	4661/2
6¾	15½	12½	51	173/4	1071/2	26½	2391/2	37½	4791/4
7	16¾	12½	531/4	18	1101/2	27	2481/2	38	4921/4
7¼	18	12¾	551/2	18¼	1132	27½	2573/4	38½	5054/4
7½	19¼	13	571/2	18½	1161/4	28	2671/4	39	5181/2
7¾	20½	13½	593/4	183/4	1193/4	28½	2763/4	39½	5313/4
8	213/4	13½	621/4	19	123	29	2861/2	40	5451/2
8¼	23¼	13¾	641/2	19¼	1261/4	29½	2961/2		

TABLE SHOWING the WEIGHT of WATER at DIFFERENT TEMPERATURES.

Temp Farh.	W'g't of a Cubic foot.	Temp. Farh.	W'g't of a Cubic foot.	Temp. Farh.	W'g't of a Cubic foot.	Temp. Farh.	W'g't of a Cubic foot.
40°	62.408	102°	61.092	172°	60.72	275°	58.17
42	62.406	112	61.078	182	60.55	300	57.42
52	62.377	122	61.063	192	60.28	350	55.94
62	62.321	132	61.047	202	60.05	400	54.34
72	62.025	142	61.030	212	59.82	450	52.70
82	62.015	152	61.011	230	59.37	500	51.02
92	62.004	162	60.920	250	58.85	600	47.64

The boiling point of water decreases one degree (on an average) for every 530 feet above sea level. The boiling point at sea level being 212 degrees.

DIMENSIONS OF BOLT AND NUTS SQUARE AND HEXAGONAL.

Diameter of Bolt.	Depth of Nut.	Width of Sq. Nut.	Diam. of Hex'l Nut	Width of Head.	VOLUME.			
					Hexa'l Nut.	Square Nut.	Hexa'l Head.	Bolt per inch of Length.
Ins.	Ins	Ins	Ins.	Ins.	Cu. Ins.	Cu. Ins.	Cu. Ins.	Cu. Ins.
1/8	.15	.2	1/4	.2	.00425	.00416	.0045	.01227
3-16	.2	.3	3/8	.3	.01276	.01248	.0152	.02761
1/4	.25	.45	1/2	.4	.02836	.03835	.036	.04908
5-16	.35	.55	5/8	.5	.06235	.07903	.07	.07669
3/8	.4	.6	3/4	.6	.10209	.09984	.1215	.1104
7-16	.5	.75	7/8	.7	.17368	.2061	.1929	.1503
1/2	.55	.85	1	.75	.25584	.28941	.2531	.1963
9-16	.6	.95	1 1/8	.85	.34449	.3924	.3658	.2485
5/8	.7	1.1	1 1/4	.95	.49625	.6323	.5076	.3067
11-16	.75	1.2	1 3/8	1.05	.64328	.8016	.6822	.3712
3/4	.8	1.3	1 1/2	1.125	.81664	.9986	.8543	.4417
13-16	.9	1.4	1 5/8	1.25	1.0782	1.2977	1.143	.5184
7/8	.95	1.5	1 3/4	1.35	1.3199	1.5663	1.435	.6013
1	1.1	1.75	2	1.5	1.996	2.5048	2.025	.7854
1 1/8	1.25	1.95	2 1/4	1.7	2.8701	3.5106	2.926	.994
1 1/4	1.37	2.15	2 1/2	1.875	2·8846	4.6518	3.955	1.227
1 3/8	1.5	2.4	2 3/4	2.1	5.1474	6.414	5.457	1.484
1 1/2	1.65	2.6	3	2.25	6.737	8.2384	6.884	1.767
1 5/8	1.8	2.8	3 1/4	2.45	8.6267	10.381	8.778	2.073
1 3/4	1.9	3.	3 1/2	2.625	10.559	12.53	10.853	2.405
1 7/8	2.05	3.25	3 3/4	2.8	13.058	15.993	13.23	2.761
2	2.2	3.45	4	3.	15.97	19.275	16.2	3.141

MARKS and weight of ENGLISH Tin-Plates.

Brand.	Plates per Box.	Length and Breadth.	Net W'g't per Box.
	No.	Inches.	lbs.
1C or 1 com	225	13 3/4 by 10	112
2C	"	13 1/4 " 9 3/4	105
3C	"	12 3/4 " 9 1/2	98
HC	"	13 3/4 " 10	119
HX	"	13 3/4 " 10	157
1X	"	13 3/4 " 10	140
2X	"	13 1/4 " 9 3/4	133
3X	"	12 3/4 " 9 1/2	126
1XX	"	13 3/4 " 10	161
1XXX	"	13 3/4 " 10	182
1XXXX	"	13 3/4 " 10	203
1XXXXX	"	13 3/4 " 10	224
1XXXXXX	"	13 3/4 " 10	245
DC	100	16 3/4 " 12 1/2	98
DX	"	16 3/4 " 12 1/2	126

MARKS and weight of ENGLISH Tin-Plates. (*Continued*).

Brand.	Plates per Box.	Length and Breadth.	Net W'g't per Box.
	No.	Inches.	lbs.
DXX	100	16¾ " 12½	147
DXXX	"	16¾ " 12½	168
DXXXX	"	16¾ " 12½	189
SDC	200	15 " 11	168
SDX	"	15 " 11	188
SDXX	"	15 " 11	209
SDXXX	"	15 " 11	230
SDXXXX	"	15 " 11	251
SDXXXXX	"	15 " 11	272
SDXXXXXX	"	15 " 11	293
Leaded IC	112	20 " 14	112
" IX	112	20 " 14	140
ICW	225	13¾ " 10	112
IXW	225	13¾ " 10	140
CSDW	200	15 " 11	168
CIIW	100	16¾ " 12½	105
XIIW	100	16¾ " 12½	126
TT	450	13¾ " 10	112
XTT	450	13¾ " 10	126

NOTE:—When the plates are 14 by 20 inches there are 112 in a box.

Table of Standard Dimensions of Wrought Iron Welded Tubes.

Nominal Diameter.	External Diameter.	Thickness.	Internal Diameter.	Internal Circum.	External Circum.	Length of pipes per sq. foot of Int'al and Extern'l sufaces.		Internal area.	Weight per ft.	No. of threads per inch of Screw.
						In'l.	Ex'l.			
Ins.	Ins.	Ins	Ins.	Ins.	Ins.	Feet	Feet	Ins.	lbs.	
⅛	.40	.068	.27	.85	1.27	14.15	9.44	.057	.24	27
¼	.54	.088	.36	1.14	1.7	10.5	7.075	.104	.42	18
⅜	.67	.091	.49	1.55	2.12	7.67	5.657	.192	.56	18
½	.84	.109	.62	1.96	2.65	6.13	4.502	.305	.84	14
¾	1.05	.113	.82	2.59	3.3	4.64	3.637	.533	1.13	14
1	1.31	.134	1.05	3.29	4.13	3.66	2.903	.863	1.67	11½
1¼	1.66	.14	1.38	4.33	5.21	2.77	2.301	1.496	2.26	11½
1½	1.9	.145	1.61	5.06	5.97	2.37	2.10	2.038	2.69	11½
2	2.37	.154	2.07	6.49	7.46	1.85	1.611	3.355	3.67	11½
2½	2.87	.204	2.47	7.75	9.03	1.55	1.324	4.783	5.77	8
3	3.5	.217	3.07	9.64	11.	1.24	1.091	7.388	7.55	8

(TABLE CONTINUED).

Nominal Diameter.	External Diameter.	Thickness.	Internal Diameter.	Internal Circum.	External Circum.	Length of pipes per sq. foot of Int'al and Exter'al surfaces.		Internal area.	Weight per ft.	No. of threads per inch of Screw.
						In'l.	Ex'l.			
Ins.	Ins.	Ins	Ins.	Ins.	Ins.	Feet	Feet	Ins.	lbs.	
3½	4.	.226	3.55	11.15	12.57	1.08	0.995	9.887	9.05	8
4	4.5	.237	4.07	12.69	14.14	.95	0.849	12.73	10.73	8
4½	5.	.247	4.51	14.15	15.71	.85	0.765	15.939	12.49	8
5	5.56	.259	5.04	15.85	17.47	.78	0.629	19.99	14.56	8
6	6.62	.28	6.06	19.05	20.81	.63	0.577	28.889	18.77	8
7	7.62	.301	7.02	22.00	23.95	.54	0.505	38.737	23.41	8
8	8.62	.322	7.98	25.08	27.1	.48	0.444	50.039	28.35	8
9	9.69	.344	9.	28.28	30.43	.42	0.394	63.633	34.08	8
10	10.75	.366	10.02	31.47	33.77	.38	0.355	78.838	40.64	8

Tables of the different quantities of Coal-gas of the Specific gravity .420, delivered in one hour, from horizontal pipes of different diameters and lengths, and under different pressure.

Quantities delivered by a 2 inch main in Cubic feet.

Length of pip's in yds.	Pressure in inches and parts.			Perpendicular Head of water.		
	0.50	0.75	1.00	1.50	2.00	3.00
10	2896	3558	4135	4923	5792	6950
15	2364	2904	3331	4080	4728	5768
20	2047	2507	2886	3541	4094	4994
25	1830	2241	2580	3165	3660	4465
30	1673	2049	2368	2894	3346	4082
40	1445	1770	2037	2490	2890	3525
50	1294	1585	1824	2238	2588	3157
100	915	1121	1290	1582	1830	2232
150	748	916	1054	1304	1496	1825
200	647	792	912	1119	1294	1578
250	579	709	816	1010	1158	1412
300	522	639	736	903	1044	1273
400	457	559	644	790	914	1115
500	409	500	576	707	818	997

For a 4 inch main multiply by 4
" an 8 " " " " 16
" a 1 " " divide " 4

Rule:—The discharge of the same gas through different openings and under the same pressure are proportional to the areas of the orifices in circular inches, or to the square of their diameters.

QUANTITIES DELIVERED BY A 6 INCH MAIN IN CUBIC FEET.

Length of pipe in yds.	Pressure in inches and parts.			Perpendicular Head of water.		
	0.50	0.75	1.00	1.50	2.00	3.00
100	8240	10095	11657	14276	16484	20190
150	6730	8242	9517	11657	13460	16484
200	5828	7138	8242	10095	11657	14276
300	4759	5828	6730	8242	9517	11657
400	3929	4813	5557	6806	7858	9626
500	3686	4515	5213	6384	7372	9030
600	3365	4121	4759	5828	6730	8242
700	3115	3816	4406	5396	6230	7632
800	2778	3403	3929	4813	5557	6807
900	2747	3365	3886	4759	5494	6730
1000	2606	3192	3686	4515	5213	6384
1760	1965	2406	2778	3403	3929	4813
2640	1604	1965	2269	2778	3208	3929
3520	1389	1702	1965	2406	2778	3403
5280	1134	1389	1604	1965	2269	2778
7040	982	1149	1389	1702	1965	2298
8800	879	1076	1287	1521	1758	2152
10000	824	1010	1166	1428	1648	2019

For a 12 inch main multiply by 4
" "24 " " " "16
" " 3 " " divide " 4

Diameter and length of gas-pipe to transmit given volumes of gas to branch.

Diam-eter.	Length.	Volume per hour.	Diam-eter.	Length.	Volume per hour.
Ins	Feet.	Cub. Ft.	Ins.	Feet.	C. Ft.
.4	100	50	5.32	2000	2000
1.	200	250	6.33	4000	2000
1.97	600	500	7.	6000	2000
2.65	1000	700	7.75	1000	6000
3.16	1000	1000	9.21	2000	6000
3.87	1000	1500	10.95	1000	8000

The pressure with which gas is forced through pipes should seldom exceed 2½ inches of water at the Works, or the leakage will exceed the advantages to be obtained from increased pressure.

When pipes are laid at an inclination either above or below the horizon, a correction will have to be made in estimating the supply, by adding or deducting $\frac{1}{100}$ of an inch from the initial pressure for every foot of rise or fall in the length of the pipe.

Size of pipe required to furnish gas from the main from 2 lamps to 30.

Number of Lamps.	Length from Main.	Diam. of Pipe.	Number of Lamps.	Length from Main.	Diam. of Pipe.
	Feet.	Ins.		Feet.	Ins.
2	40	3/8	15	130	1
3	30	3/8	20	150	1 1/4
4	40	1/2	25	180	1 3/4
6	50	5/8	30	200	1 1/2
10	100	3/4			

Regulation of the diameter and Extreme length of Tubing and number of burners permitted.

Diameter of Tubing.	Length.	Number of Burners	Capacity of Meters.	Number of Burners
Ins.	Feet.		Light.	
1/4	6	1	3	6
3/8	20	3	5	10
1/2	30	6	10	20
5/8	40	12	20	40
3/4	50	20	30	60
1	70	35	45	90
1 1/4	100	60	60	120
1 1/2	150	100	100	200
2	200	200		

HOW TO TELL THE STATE OF THE METER.

Each figure or division, on the different dials of the Index, indicates as follows: On the right hand dial, 100, 200, 300 cubic feet, &c.; on the middle dial, 1,000, 2,000. 3,000, &c.; on the left hand dial, 10,000, 20,000, 30,000, &c.

Look at the left hand dial, and set down the figure at the least value next the pointer, which, on the above diagram, is 1. Next look at the middle dial. As before, set down the least figure next the pointer, which, in the diagram, is 3. Next, look at the right hand dial. Take whichever figure is nearest, which, in the diagram is 5. Set all these figures down, thus: 135, and add two ciphers, to represent hundreds, and you have 13,500, which is the present state of the meter. If a previous observation has been taken, subtract the state of the meter at that observation from the present state, and the difference is the amount consumed in interval.

STRENGTH of MATERIALS.

A Table of the depths of square beams or bars of Cast-Iron, calculated to support from 1 cwt to 14 tons in the middle, the Deflexion not to exceed 1-40 of an inch for each foot in length.

Weight in cwts.	Weight in lbs.	LENGTH IN FFET.												
		4	6	8	10	12	14	16	18	20	22	24	26	28
		DEPTH IN INCHES.												
1	112	1.2	1.4	1.7	1.9	2. 0	2.2	2.4	2.5	2.6	2.7	2.9	3.0	3.1
2	224	1.4	1.7	2.0	2.2	2. 4	2.6	2.8	3.0	3.1	3.3	3.4	3.6	3.7
3	336	1.6	1.9	2.2	2.4	2. 7	2.9	3.1	3.3	3.4	3.6	3.8	3.9	4.1
4	448	1.7	2.0	2.4	2.6	2. 9	3.1	3.3	3.5	3.7	3.9	4.0	4.2	4.3
5	560	1.8	2.2	2.5	2.8	3. 0	3.3	3.5	3.7	3.9	4.1	4.3	4.4	4.6
6	672	1.8	2.2	2.6	2.9	3. 2	3.4	3.7	3.9	4.1	4.3	4.5	4.6	4.8
7	784	1.9	2.3	2.7	3.0	3. 3	3.6	3.8	4.1	4.2	4.4	4.6	4.8	5.0
8	896	2.0	2.4	2.8	3.1	3. 4	3.7	3.9	4.2	4.4	4.6	4.8	5.0	5.2
9	1.008	2.0	2.5	2.9	3.2	3. 5	3.8	4.0	4.3	4.5	4.7	4.9	5.1	5.3
10	1.120	2.1	2.6	3.0	3.3	3. 6	3.9	4.2	4.4	4.7	4.9	5.2	5.3	5.4
11	1.232	2.1	2.6	3.0	3.4	3. 7	4.0	4.3	4.5	4.8	5.0	5.3	5.4	5.6
12	1.344	2.2	2.7	3.1	3.5	3. 8	4.1	4.4	4.7	4.9	5.1	5.3	5.5	5.7
13	1.456	2.2	2.7	3.1	3.5	3. 8	4.2	4.4	4.7	4.9	5.2	5.4	5.6	5.9
14	1.568	2.3	2.8	3.2	3.6	3. 9	4.2	4.5	4.8	5.0	5.3	5.5	5.7	6.0
15	1.680	2.3	2.8	3.2	3.6	4. 0	4.3	4.6	4.9	5.2	5.4	5.6	5.8	6.1
16	1.792	2.4	2.9	3.3	3.7	4. 0	4.4	4.7	5.0	5.2	5.5	5.7	5.9	6.2
17	1.904	2.4	2.9	3.4	3.8	4. 1	4.4	4.7	5.0	5.3	5.5	5.8	6.0	6.2
18	2.016	2.4	3.0	3.4	3.8	4. 2	4.5	4.8	5.1	5.4	5.6	5.9	6.1	6.4
19	2.128	2.5	3.0	3.5	3.9	4. 2	4.6	4.9	5.2	5.4	5.7	6.0	6.2	6.5
1 T	2.240	2.5	3.0	3.5	3.9	4. 3	4.6	4.9	5.2	5.5	5.8	6.0	6.3	6.5
1¼	2.800	2.6	3.2	3.7	4.1	4. 5	4.9	5.2	5.5	5.8	6.1	6.4	6.6	6.9
1½	3.360	2.8	3.4	3.9	4.3	4. 7	5.1	5.5	5.8	6.1	6.4	6.7	7.0	7.2
1¾	3.920	2.9	3.5	4.0	4.5	4. 9	5.3	5.7	6.0	6.3	6.7	6.9	7.2	7.5
2	4.480	2.9	3.5	4.1	4.7	5. 1	5.5	5.9	6.2	6.5	6.8	7.2	7.6	7.7
2½	5.600	3.1	3.8	4.4	4.9	5. 5	5.8	6.2	6.6	6.9	7.3	7.6	7.9	8.2
3	6.720	3.3	4.0	4.6	5.1	5. 7	6.1	6.5	6.9	7.3	7.6	7.9	8.3	8.6
3½	7.840	3.4	4.1	4.8	5.3	5. 8	6.3	6.7	7.1	7.5	7.9	8.2	8.6	8.9
4	8.960	3.5	4.3	4.9	5.5	6. 0	6.5	7.0	7.4	7.8	8.2	8.5	8.9	9.2
4½	10.080		4.4	5.1	5.7	6. 2	6.7	7.2	7.6	8.0	8.4	8.8	9.1	9.5
5	11.200		4.5	5.2	5.8	6. 4	6.9	7.4	7.8	8.2	8.6	9.0	9.4	9.7
6	13.440			5.5	6.1	6. 7	7.2	7.7	8.2	8.6	9.0	9.4	9.8	10.2
7	15.680			5.7	6.3	6. 9	7.5	8.0	8.5	8.9	9.4	9.8	10.2	10.6
8	17.920			5.9	6.6	7. 2	7.8	8.3	8.8	9.3	9.7	10.1	10.6	10.9
9	20.160			6.0	6.8	7. 4	8.0	8.5	9.0	9.5	10.0	10.4	10.9	11.3
10	22.400				6.9	7. 6	8.2	8.8	9.3	9.8	10.3	10.7	11.2	11.6
11	24.640				7.1	7. 8	8.4	9.0	9.5	10.0	10.5	11.0	11.5	11.9
12	26.880				7.2	7. 9	8.6	9.2	9.7	10.2	10.8	11.2	11.7	12.1
13	29.120				7.4	8. 1	8.8	9.4	9.9	10.4	11.0	11.5	11.9	12.4
14	31.360				7.5	8. 3	8.9	9.5	10.1	10.6	11.1	11.7	12.1	12.6

Deflexion in Inches.	.1	.15	.2	.25	.3	.35	.4	.45	.5	.55	.6	.65	.7

TABLE (Continued).

Weight in tons.	Weight in lbs.	Length in Feet. 10	12	14	16	18	20	22	24	26	28	30
		Depth in Inches.										
15	33600	7.7	8.4	9.1	9.7	10.3	10.8	11.4	11.9	12.3	12.8	13.2
16	35840	7.8	8.5	9.2	9.8	10.4	11.0	11.5	12.0	12.5	13.0	13.5
17	38080	7.9	8.7	9.4	10.0	10.6	11.2	11.7	12.2	12.7	13.2	13.7
18	40320	8.0	8.8	9.5	10.1	10.8	11.3	11.9	12.4	12.9	13.4	13.9
19	42560	8.1	8.9	9.6	10.3	10.9	11.5	12.2	12.6	13.1	13.6	14.1
20	44800		9.0	9.7	10.4	11.0	11.6	12.5	12.7	13.2	13.8	14.2
22	49280		9.2	10.0	10.7	11.3	11.9	12.8	13.0	13.6	14.1	14.6
24	53760		9.4	10.2	10.9	11.5	12.2	13.0	13.4	13.9	14.4	14.9
26	58240		9.6	10.4	11.1	11.8	12.4	13.3	13.6	14.2	14.7	15.2
28	62720		9.8	10.6	11.4	12.0	12.7	13.5	13.9	14.4	15.0	15.5
Deflexion in Inches.		.25	.3	.35	.4	.45	.5	.55	.6	.65	.7	.75

Length in Feet.		14	16	18	20	22	24	26	28	30	32	34
30	67200	10.8	11.5	12.2	12.9	13.5	14.1	14.7	15.2	15.7	16.3	16.8
32	71680	11.0	11.7	12.4	13.1	13.7	14.3	14.9	15.5	16.0	16.5	17.0
34	76160	11.1	11.9	12.6	13.3	13.9	14.5	15.1	15.7	16.2	16.8	17.3
36	80640	11.3	12.0	12.8	13.4	14.1	14.7	15.3	15.9	16.5	17.0	17.5
38	85120	11.4	12.2	13.0	13.6	14.3	14.9	15.5	16.1	16.7	17.2	17.8
40	89600		12.4	13.1	13.8	14.5	15.1	15.7	16.4	16.9	17.5	18.0
42	94080		12.5	13.3	14.0	14.7	15.3	15.9	16.5	17.1	17.7	18.2
44	98560		12.7	13.5	14.2	14.9	15.5	16.1	16.8	17.4	17.9	18.5
46	103040		12.8	13.6	14.3	15.0	15.7	16.3	17.0	17.6	18.1	18.7
48	107520		13.0	13.7	14.5	15.2	15.9	16.5	17.1	17.7	18.3	18.8
50	112000			13.8	14.6	15.3	16.0	16.6	17.3	17.9	18.5	19.0
52	116480			14.0	14.7	15.5	16.2	16.8	17.5	18.1	18.7	19.2
54	120960			14.1	14.9	15.7	16.3	17.0	17.6	18.2	18.8	19.4
56	125440			14.3	15.0	15.8	16.5	17.1	17.8	18.4	19.0	19.6
58	129920			14.4	15.1	15.9	16.6	17.3	17.9	18.5	19.2	19.7
60	134400			14.5	15.3	16.0	16.7	17.4	18.1	18.7	19.3	19.9
Deflexion in Inches.		35	.4	.45	.5	.55	.6	.65	.7	.75	.8	.85

Examples illustrative of the Table:—1 To find the depth of a rectangular bar of cast-iron to support a weight of 10 tons in the middle of its length the deflexion not to exceed 1-40 of an inch per foot in length, and its length 20 feet, also let the depth be six times the breadth.

Opposite six times the weight an under 20 ft. in length is 15.3 inches, the depth, and 1-6 of 15.3=2.6 inches, the breadth.

(2). To find the diameter for cast-iron shaft or solid cylinder that will bear a given pressure the flexure in the

middle not to exceed 1-40 of an inch for each foot of its length, the distance of the bearing being 20 ft. and on the middle equals 10 tons.

Constant multiplier 1.7 for round shafts, then $10 \times 1.7 = 17$. and opposite 17 tons and under 20 ft. is 11.2 inches for the diameter. But half that flexure is quite enough for revolving shafts; hence $17 \times 2 = 34$ tons, and opposite 34 tons is 13.3 inches for the diameter.

Tensile Strength of Metals. Weight necessary to tear asunder one square inch.

Name of Materials.	In pounds Avoirdupois.	In Tons of 2,000 lbs.
Antimony Cast.	1.060	0.5
Bismuth "	3.250	1.6
Brass, fine yellow cast.	17.968	8.9
" Wire.	49.000	24.5
Copper Cast.	19.000	9.5
" Sheets.	30.000	15.0
" Bolts.	33.000	16.5
" Wire.	60.000	30.0
Gun metal.	36.000	18.0
Lead Cast.	1.824	0.9
" Sheet.	3.300	1.6
Steel.	111.500	57.5
Tin Cast.	4.600	2.3
Platinum.	56.000	28.0
Silver.	40.000	20.0
Gold Cast.	20.000	10.0
" Wire.	30.000	15.0
Zinc.	7.500	3.5
Cast-Iron.	20.834	10.4
Wrought-Iron.	56.000	28.0
Cast Steel.	88.600	44.3

RELATIVE POWER of METAL to RESIST TORISON, WROUGHT-IRON BEING UNITY.

Wrought-Iron	1.
Cast-Iron	.90
Cast-Steel	1.93
Gun Metal	.27
Brass	.23
Copper	.22
Tin	.13
Lead	.10

Strength of White Pine Struts or Pillars.

(Moderately Seasoned).

Length in feet.	Dimensions of Cross-Sections in inches.							
	4×5	4×6	4×7	4×8	4×9	4×10	4×11	4×12
	Safe load in Tons of 2000 lbs.							
6	4.1	5.0	5.8	6.6	7.4	8.3	9.1	9.9
7	3.8	4.5	5.3	6.0	6.8	7.5	8.3	9.0
8	3.5	4.2	4.9	5.6	6.3	7.0	7.7	8.4
9	3.2	3.9	4.6	5.2	5.9	6.5	7.2	7.8
10	2.9	3.5	4.0	4.6	5.2	5.8	6.3	6.9
11	2.6	3.2	3.7	4.2	4.7	5.3	5.8	6.3
12	2.4	2.9	3.3	3.8	4.3	4.7	5.2	5.7
13	2.0	2.4	2.8	3.2	3.6	4.0	4.4	4.8
14	1.8	2.1	2.5	2.8	3.2	3.5	3.9	4.2
15	1.4	1.7	1.9	2.2	2.5	2.8	3.0	3.3
16	1.1	1.4	1.6	1.8	2.0	2.3	2.5	2.7
17	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4
18	0.9	1.1	1.2	1.4	1 6	1.8	1.9	2.1
	5×5	5×6	5×7	5×8	5×9	5×10	5×11	5×12
8	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0
9	4.7	5.6	6.6	7.5	8.5	9.4	10.3	11.3
10	4.4	5.3	6.2	7.0	7.9	8.8	9.7	10.6
11	4.1	4.9	5.7	6.6	7.4	8.2	9.0	9.8
12	3.8	4.6	5.3	6.1	6.8	7.6	8.4	9.1
13	3.5	4.2	4.9	5.6	6.4	7.0	7.7	8.4
14	3.2	3.8	4.5	5.1	5.8	6.4	7.0	7.7
15	2.9	3.5	4.1	4.6	5.2	5.8	6.4	7.0
16	2.6	3.1	3.6	4.2	4.7	5.2	5.7	6.2
17	2.3	2.8	3.2	3.7	4.1	4.6	5.1	5.5
18	2.1	2.5	2.9	3.4	3.8	4.2	4.6	5.0
19	1.8	2.2	2.5	2.9	3.2	3.6	4.0	4.3
20	1.5	1.8	2.1	2.4	2.7	3.0	3.2	3.6
	6×5	6×6	6×7	6×8	6×9	6×10	6×11	6×12
10	6.9	7.1	8.3	9.5	10.7	11.8	13.0	14.2
11	5.6	6.7	7.8	8.9	10.0	11.2	12.3	13.4
12	5.3	6.3	7.4	8.4	9.5	10.5	11.5	12.6
13	5 0	5.9	6.9	7.9	8.8	9.8	10.8	11.8
14	4.7	5.6	6.5	7.5	8.4	9.3	10.3	11.2
15	4.4	5.3	6.2	7.1	7.9	8.8	9.7	10.6
16	4.1	4.9	5.7	6.5	7.3	8.2	9.0	9.8
17	3.8	4.5	4.3	5.9	6.8	7.5	8.3	9.0
18	3.5	4.2	4.9	5.6	6.3	7.0	7.7	8.4
19	3.2	3.8	4.4	5.1	5.7	6.4	7.0	7.6
20	3.0	3.5	4.1	4.7	5.2	5.8	6.4	7.0
21	2.6	3.1	3.6	4.1	4.7	5.2	5.7	6.2
22	2.3	2.8	3.3	3.7	4.2	4.7	5.2	5.6

Strength of White Pine Struts or Pillars. (*Continued*).

(Moderately Seasoned).

Length in feet.	Dimensions of Cross-Sections in inches.							
	7×5	7×6	7×7	7×8	7×9	7×10	7×11	7×12
	Safe load in Tons of 2000 lbs.							
10	8.7	9.2	10.8	12.3	13.9	15.4	16.9	18.4
11	7.2	8.6	10.1	11.5	13.0	14.4	15.8	17.2
12	6.8	8.0	9.5	10.9	12.2	13.6	15.0	16.0
13	6.5	7.7	9.0	10.3	11.6	13.0	14.2	15.4
14	6.2	7.4	8.6	9.8	11.1	12.4	13.5	14.8
15	5.9	7.0	8.2	9.4	10.5	11.8	12.9	14.0
16	5.6	6.7	7.8	8.9	10.0	11.2	12.2	13.4
17	5.3	6.4	7.4	8.5	9.5	10.6	11.7	12.8
18	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0
19	4.7	5.6	6.6	7.5	8.5	9.4	10.3	11.2
20	4.4	5.2	6.1	7.0	7.8	8.8	9.6	10.4
21	4.1	4.9	5.7	6.5	7.3	8.2	8.9	9.8
22	3.8	4.6	5.3	6.1	6.8	7.6	8.4	9.2
	8×5	8×6	8×7	8×8	8×9	8×10	8×11	8×12
10	9.6	11.5	13.4	15.3	17.2	19.2	21.0	23.0
11	9.0	10.8	12.6	14.4	16.2	18.0	19.8	21.6
12	8.5	10.2	11.9	13.6	15.3	17.0	18.7	20.4
13	8.1	9.7	11.3	12.9	14.5	16.2	17.7	19.4
14	7.7	9.2	10.8	12.3	13.9	15.4	16.9	18.4
15	7.3	8.8	10.2	11.7	13.1	14.6	16.1	17.6
16	7.0	8.4	9.8	11.2	12.6	14.0	15.4	16.8
17	6.7	8.0	9.4	10.7	12.1	13.4	14.7	16.0
18	6.4	7.7	9.0	10.2	11.5	12.8	14.1	15.4
19	6.1	7.4	8.5	9.7	10.9	12.2	13.3	14.8
20	5.8	7.0	8.1	9.3	10.4	11.6	12.8	14.0
21	5.5	6.6	7.7	8.8	9.9	11.0	12.1	13.2
22	5.3	6.3	7.4	8.4	9.5	10.6	11.6	12.6
	9×5	9×6	9×7	9×8	9×9	9×10	9×11	9×12
10	11.9	14.3	16.7	19.2	21.5	23.8	26.3	28.6
11	11.0	13.1	15.3	17.6	19.7	22.0	24.1	26.2
12	10.3	12.4	14.4	16.4	18.5	20.6	22.7	24.8
13	9.8	11.7	13.7	15.6	17.5	19.6	21.5	23.4
14	9.3	11.3	13.0	14.8	16.7	18.6	20.5	22.6
15	8.9	10.7	12.5	14.2	16.0	17.8	19.6	21.4
16	8.5	10.2	11.9	13.6	15.3	17.0	18.7	20.4
17	8.2	9.8	11.4	13.0	14.7	16.4	17.9	19.8
18	7.9	9.5	11.1	12.6	14.2	15.8	17.4	19.0
19	7.6	9.1	10.7	12.0	13.7	15.2	16.7	18.2
20	7.3	8.7	10.2	11.6	13.1	14.6	16.0	19.4
21	7.0	8.4	9.8	11.2	12.6	14.0	15.4	17.8
22	6.8	8.1	9.5	10.8	12.1	13.6	14.9	16.2

Strength of White Pine Struts or Pillars. (*Continued*).

(Moderately Seasoned).

Length in feet.	Dimensions of Cross-Sections in inches.						
	10×6	10×7	10×8	10×9	10×10	10×11	10×12
	Safe load in Tons of 2000 lbs.						
10	17.5	20.4	23.4	26.3	29.2	32.1	35.0
11	16.2	18.9	21.6	24.3	27.0	29.7	32.4
12	15.1	17.6	20.0	22.6	25.1	27.6	32.2
13	14.2	16.6	19.0	21.3	23.7	26.1	28.4
14	13.5	15.8	18.0	20.3	22.5	24.8	27.0
15	12.9	15.1	17.2	19.4	21.5	23.7	25.8
16	12.3	14.4	16.4	18.5	20.5	22.6	24.6
17	11.8	13.7	15.6	17.6	19.6	21.6	23.6
18	11.3	13.1	15.2	17.0	18.9	20.8	22.6
19	10.9	12.7	14.6	16.4	18.2	20.0	21.8
20	10.5	12.2	14.0	15·8	17.5	19.3	21.0
21	10.0	11.7	13.4	15.0	16.7	18.4	20.0
22	9.6	11.2	12.8	14.4	16.0	17.6	19.2
	11×6	11×7	11×8	11×9	11×10	11×11	11×12
12	18.0	21.0	24.0	27.0	30.0	33.0	36.0
13	16.9	19.7	22.6	25.4	28.2	31.0	33.8
14	16.0	18.7	21.0	24.0	26.8	29.4	32.0
15	15.4	17.9	20.4	23.0	25.6	28.1	30.8
16	14.7	17.2	19.6	22.0	24.6	26.9	29.4
17	14.2	16.5	18.8	21.2	23.6	25.9	28.4
18	13.5	15.8	18.0	20.3	22.6	24.9	27.0
19	13.0	15.2	17.4	19.5	21.8	23.9	26.0
20	12.5	14.6	16.8	18.8	21.0	23.0	25.0
21	12.0	14.0	16.0	18.0	20.0	22.0	24.0
22	11.6	13.5	15.4	17.4	19.4	21.2	23.2
23	11.2	13.0	14.8	16.7	18.6	20.5	22.4
24	10.8	12.6	14.4	16.2	18.0	19.8	21.6
	12×6	12×7	12×8	12×9	12×10	12×11	12×12
12	21.0	24.5	28.0	31.5	35.0	38.5	42.0
13	19.9	23.2	26.4	29.8	33.2	36.4	39.7
14	18.8	21.9	25.0	28.1	31.4	34.4	37.6
15	17.9	20.9	23.8	26.8	29.8	32.8	35.8
16	17.1	20.0	22.8	25.7	28.6	31.4	34.2
17	16.4	19.1	21.8	24.6	27.4	30.0	32.7
18	15.7	18.3	21.0	23.6	26.2	28.8	31.4
19	15.1	17.6	20.2	22.7	25.2	27.7	30.2
20	14.6	17.0	19.4	21.9	24.4	26.7	29.2
21	14.1	16.5	18.8	21.2	23.6	25.8	28.2
22	13.6	15.9	18.2	20.5	22.8	25.0	27.2
23	13.1	15.3	17.4	19.6	21.8	24.0	26.2
24	12.6	14.7	16.8	18.9	21.0	23.1	25.2

The strength of pillars, as well as of beams of timber, depend much on their *degree* of *seasoning.*

Well seasoned timber will stand 1½ to 2 times the weight that green timber will. In the same class of timber the slower the growth or the narrower the annular rings the better. In the same class the heavier the better. If the wood has color, deepness of color indicates strength and durability. The freshly-cut surface of wood should be firm, shining, and somewhat translucent. A dull, chalky appearance is a sign of bad timber. In resinous timber, those with least resin in their pores are strongest and most durable. In non-resinous timber, those with least sap or gum are best.

Weight that can be borne with safety by Cast-Iron Columns in 1000 lbs. (Trenton Iron Co).

American Iron.

Length in Feet.	Diameter in Inches.						
	2	3	4	5	6	7	8
5	12.4	44	102	184	288	414	560
6	9.4	36	88	164	264	386	532
7	7.2	30	76	146	242	360	502
8		24	66	130	218	332	470
9		20	56	114	198	306	440
10		18	48	102	180	282	410
12			38	80	136	238	354
14			28	64	122	200	304
16				52	100	170	262
18				44	84	144	226
20					72	124	196

Length in Feet.	Diameter in Inches.						
	9	10	11	12	13	14	15
5	728	916	1126	1354			
6	698	884	1082	1320	1570		
7	660	850	1056	1282	1530	1798	2086
8	630	812	1016	1240	1486	1754	2040
9	596	774	974	1196	1440	1706	1992
10	560	739	932	1152	1392	1656	1940
12	494	658	846	1056	1292	1550	1828
14	432	586	774	966	1192	1440	1712
16	378	520	686	878	1094	1332	1596
18	332	462	616	796	1000	1228	1482
20	292	410	552	720	912	1130	1372

Safe Load for Hollow Cast-Iron Pillars. (Tons 2240 lbs).

External Diam. in Ins.	*LENGTH IN FEET.*				
	8	10	12	14	16
	Tons.	Tons.	Tons.	Tons.	Tons.
Thickness of Metal=1/2 Inch.					
3	4.0	3.2	2.3	1.8	1.4
3½	5.9	5.1	3.6	2.7	2.3
4	8.1	6.1	4.7	3.6	3.4
4½	10.6	8.1	6.5	5.0	4.4
5	13.3	10.4	8.3	6.7	5.4
5½	15.3	12.9	10.5	8.5	7.0
6	19.0	15.5	12.7	9.5	8.7
Thickness of Metal=5/8 Inch.					
3	4.7	3.5	2.6	2.0	1.6
3½	7.1	5.3	4.2	3.2	2.5
4	9.2	7.3	5.6	4.4	3.9
4½	12.8	9.9	7.7	6.1	5.5
5	16.1	12.7	9.1	8.1	7.0
5½	18.7	15.7	12.8	10.4	8.8
6	23.2	19.0	15.6	12.8	10.6
6½	26.9	22.4	18.7	15.2	13.0
7	30.7	26.0	21.9	18.5	15.6
Thickness of Metal=3/4 Inch.					
3	5.4	3.8	2.8	2.2	1.7
3½	8.1	6.2	4.4	3.5	2.6
4	11.3	8.5	6.5	4.8	3.8
4½	14.9	11.5	8.9	7.2	6.0
5	18.8	14.8	11.7	9.0	7.7
5½	21.8	18.4	14.9	12.1	10.2
6	27.2	22.3	18.3	15.0	12.5
6½	31.6	26.3	21.9	17.8	15.3
7	36.1	30.6	25.8	21.7	18.4
Thickness of Metal=1 Inch.					
4	13.9	10.4	8.0	6.4	4.8
4½	18.5	14.3	11.1	8.8	7.1
5	23.6	18.6	14.8	11.9	9.6
5½	27.6	23.2	18.9	15.3	12.7
6	34.5	28.3	23.2	19.1	15.9
6½	40.3	33.6	28.0	22.8	19.6
7	46.2	39.1	33.0	27.8	23.6
7½	52.2	44.9	38.3	32.6	27.9
8	58.3	50.7	43.8	37.7	32.5
9	70.5	62.7	55.3	48.1	42.3

STRENGTH OF ROLLED IRON BEAMS.

Depth of Beam in Inches.	Size of Flange in Inches.	Spans in feet. 10	15	20	25
		Breaking Weight in Tons.			
5	2 by 1/2	6.6			
6	2 1/2 " 1/2	10.	6.6	5	
7	3 " 1/2	14.	9.	7	5
8	3 " 3/8	20.	13.	10	8
9	4 " 3/4	36.	24.	18	14
10	4 1/2 " 1	60.	40.	30	24

Table to show the Weight or Pressure a column of Cast-Iron will sustain with Safety in Cwts. (112 lbs).

(English Iron).

Diam. in Inches.	Height in feet. 4	6	8	10	12	14	16	18	20	22	24
2	72	60	49	40	32	26	22	18	15	13	11
2 1/2	119	105	91	77	65	55	47	40	34	29	25
3	178	162	145	129	111	97	84	73	64	56	49
3 1/2	247	232	214	191	172	156	135	119	106	94	83
4	326	310	288	266	242	220	198	179	160	144	130
4 1/2	418	400	379	354	327	301	275	251	229	208	189
5	522	501	479	452	427	394	365	337	310	285	262
6	607	592	573	550	525	497	469	440	413	386	360
7	1032	1013	989	959	924	887	848	808	765	725	686
8	1333	1315	1289	1259	1224	1185	1142	1097	1052	1005	959
9	1716	1697	1672	1640	1603	1561	1515	1467	1416	1364	1311
10	2119	2100	2077	2045	2007	1964	1916	1865	1811	1755	1697
11	2570	2550	2520	2490	2450	2410	2358	2305	2248	2189	2127
12	3050	3040	3020	2970	2930	2900	2830	2780	2730	2670	2600

If the columns are hollow, the area to the given diameter is to be converted into the ring, or the difference of the outer and inner diameters multiplied by 2/3, because hollow Cast-Iron, columns are stronger than solid ones in that proportion.

RELATIVE STIFFNESS OF MATERIALS TO RESIST A TRANSVERSE STRAIN.

Cast-Iron	1.	Oak	.095
Ash	.089	White Pine	.1
Beech	.073	Wrought-Iron	1.3
Elm	.073	Yellow Pine	.087

Table of short-linked Crane Chains and Ropes, showing the Dimensions and Weight of each and the proof of the Chain in Tons.

Diameter of Chains.	Weight per Fathom.	Proof Strain.	Circum. of Rope.	W'g't of Rope per Fathom.
Ins.	lbs.	Tons.	Ins.	lbs.
3-16	6.	.75	2½	1.5
⅜	8.5	1.5	3¼	2.5
7-16	11.	2.5	4	3.75
½	14.	3.5	4¾	5.
9-16	18.	4.5	5½	7.
⅝	24.	5.25	6¼	8.7
11-16	28.	6.5	7	10.5
¾	30.	7.75	7½	12.
13-16	36.	9.25	8¼	15.
⅞	44.	10.75	9	17.5
15-16	50.	12.5	9½	19.5
1	56.	14.	10	22.

APPROXIMATE WEIGHT AND STRENGTH OF MANILLA CORDAGE.

Size Circum'ce Inches.	Size Diameter Inches.	Weight of 100 Fathoms.	Length of One lb.	Strain Borne by New Ropes.
		lbs		lbs.
¾	¼	15	38 ft.	450
1	5-16	25	28 "	750
1⅛	⅜	29	22 "	900
1¼	7-16	31	17 "	1,250
1½	½	44	12 "	1,700
1¾	9-16	60	10 "	2,250
2	⅝	79	7½ "	3,000
2¼	¾	99	6 "	4,000
2½	13-16	122	5 "	5,000
2¾	⅞	146	4 "	6,000
3	1	176	3⅜ "	7,000
3¼	1 1-16	207	3 "	8,500
3½	1⅛	240	2½ "	9,500
3¾	1¼	275	2 1-6	11,000
4	1 5-16	305	2 "	12,500
4¼	1⅜	355	1⅔ "	14,000
4½	1½	395	1½ "	16,000

For Ropes in use deduct one-half from these figures to allow for Chafing, &c.

Relative Value of Various Woods, their Crushing Strength and Stiffness being Combined.

Ash, 5. Beech, 4.4 Cedar, 1. Elm, 4.9 English Oak, 5.7 Mahogany, 3.7 Quebec Oak, 4.6 Spruce, 3.6 Sycamore, 2.6 Teak, 9.3 Walnut, 3.2 Yellow Pine 3.

Comparative Weight and Strength of Ropes and Chain Cables length of Cables and Weight of Anchors for Vessels.

Tonnage of Ship's	Diam. of Cables	Len'th of Cabl's.	Average Weight per fathom.	Proof strain of Stud Chain Cab's	Total w'g't of Anchor Suit'ble	Approx Equiv't Circum of rope
Tons.	Ins.	Fath.	lbs.	Tons.	Cwt.	Ins.
25	1/2	120	14	4 1/2	2	4 3/4
35	9-16	120	17	5 1/2	2 1/2	5 1/2
45	5/8	120	21	7	2 3/4	6 1/4
50	11-16	120	25	8 1/2	3	7
75	3/4	120	30	10 1/8	3 1/2	7 3/4
100	13-16	150	35	13 3/4	5	8 1/2
125	7/8	180	41	18	6 1/2	9 1/2
150	15-16	180	48	22 3/4	7 1/2	10
175	1	180	54	28 1/8	9	10 3/4
200	1 1-16	180	61	34	10 1/2	11 1/4
250	1 1/8	210	68	40 1/2	12 1/2	12
300	1 3-16	210	76	47 1/2	15	12 3/4
350	1 1/4	240	84	55 1/8	17	13 1/2
400	1 5-16	240	93	63 1/4	19	14 1/4
450	1 3/8	270	102	72	21	15
500	1 7-16	270	110	81 1/4	23	15 1/2
600	1 1/2	270	122	91 1/8	26	16
700	1 9-16	300	132		30	17 1/4
800	1 5/8	300	143		32	18 1/2
900	1 11-16	300	154		35	
1000	1 3/4	300	166		38	
1200	1 13-16	300	178		40	
1400	1 7/8	300	191		43	
1600	1 15-16	300	201		46	
1800	2	300	217		48	
2000	2 1-16	300	230		50	
2500	2 1/8	330	244		53	
3000	2 1/4	360	268		57	

FLAT ROPES.

Iron Wire Rope		Steel W Rope.		Hemp Rope.			
Size in Inches.	Weight per ft. in lbs.	Size in Inches	Weight per ft. in lbs.	Size in Inches.	Weight per ft. in lbs.	Breaki'g Strain.	Work'ng Load lbs
2 1/2×1/2	2 1-5	2 1/8×3/8	1 2-5	5×1 1/4	4 1-12	23	5.800
3×5/8	2 3/4	2×1/2	1 2/3	5 3/4×1 1/2	4 3/4	28	7.150
4×11-16	4 1/4	2 3/4×5/8	2 1/2	8 1/2×2 1/4	7 2/3	45	12.300
4 5/8×3/4	5 3/4	3 1/2×5/8	3 1/3	10×2 1/2	10 1/4	60	15.000

Round Ropes.

Iron Wire Ropes.		Steel Wire Ropes.		Hemp Rope.		Chain.		Breaking Strain Tons.	Working Load Lbs.
Circumference	W'g't per 100 feet in lbs.	Circum	W'g't per 100 Feet in lbs.	Circum	Wt. per 100 feet in lbs.	Size of Link.	Wt. 100 ft. in lbs		
1¾	40	1½	25	3	63	7-16	183	5	1.666
2	52	1⅝	33	5	100	½	266	7	2.333
2¼	66	1⅞	50	5½	117	9-16	300	8½	2.666
2½	83	2	59	6	130	19-32	341	11	3.700
2¾	110	2⅛	67	6½	145	⅝	400	13	4.300
3	139	2⅜	83	7¼	185	11-16	466	15	5.000
3⅜	170	2½	91	8	236	¾	533	19	6.300
3¾	240	3⅛	130	9	297	13-16	650	24	8.000
4	260	3⅜	153	9½	330	⅞	750	28	9.400
4½	285	3½	166	10½	428	1	933	36	12.000

BURSTING AND COLLAPSING PRESSURE OF WROUGHT-IRON DRAWN TUBES (Dr. CLARK).

External Diameter.	Thickness.	Bursting per Sq. inch of Internal Surface.	Collapsing per Sq Inch of External Surface.
Ins.	Ins.	Lbs.	Lbs.
1.25	.083	7700	6500
1.375	.083	6900	5800
1.5	.083	6200	5200
1.625	.083	5700	4700
1.75	.083	5300	4300
1.875	.083	4900	4000
2.	.083	4500	3700
2.125	.095	4900	3800
2.25	.095	4600	3600
2.5	.109	4800	3600
2.75	.109	4300	3100
3.	.12	4400	3000
3.25	.12	4000	2700
3.5	.134	4200	2700
3.75	.134	3900	2400
4.	.134	3600	2100
4.25	.134	3400	1900
4.5	.134	3200	1700
4.75	.134	3000	1600
5.	.134	2800	1400
5.25	.148	3000	1400
5.5	.148	2800	1200
5.75	.148	2700	1100
6.	.148	2600	1000

TABLE of Areas and Circumferences from 1 foot to 9 feet (advancing by an inch), *or from* 1 *to* 9 *Inches* (advancing by a twelfth).

Diam.	Area.	Circum.	Diam.	Area.	Circum.
1 ft.	.7854	3.1416	5 ft.	19.635	15.708
1	.9217	3.4034	1	20.2949	15.9698
2	1.069	3.6652	2	20.9658	16.2316
3	1.2272	3.927	3	21.6476	16.4934
4	1.3963	4.1888	4	22.3403	16.7552
5	1.5763	4.4506	5	23.0439	17.017
6	1.7671	4.7124	6	23.7583	17.2788
7	1.969	4.9742	7	24.4837	17.5406
8	2.1817	5.236	8	25.201	17.8024
9	2.4053	5.4978	9	29.9673	18.0642
10	2.6398	5.7956	10	26.7254	18.326
11	2.8853	6.0214	11	27.4944	18.5878
2 ft.	3.1416	6.2832	6 ft.	28.2744	18.8496
1	3.4088	6.545	1	29.0653	19.1114
2	3.687	6.8068	2	29.867	19.3732
3	3.9761	7.0686	3	30.6797	19.635
4	4.2761	7.3304	4	31.5033	19.8968
5	4.5869	7.5922	5	32.3378	20.1586
6	4.9087	7.854	6	33.1831	20.4204
7	5.2415	8.1158	7	34.0394	20.6822
8	5.5852	8.3776	8	34.9067	20.944
9	5.9396	8.6394	9	35.7848	21.2058
10	6.305	8.9012	10	36.6738	21.4676
11	6.814	9.163	11	37.5738	21.7294
3 ft.	7.0686	9.4248	7 ft.	38.4846	21.9912
1	7.4668	9.6866	1	39.4064	22.253
2	7.8758	9.9484	2	40.339	22.5148
3	8.2958	10.2102	3	41.2826	22.7766
4	8.7267	10.472	4	42.2371	23.0384
5	9.1685	10.7338	5	43.2025	23.3002
6	9.6211	10.9956	6	44.1787	23.562
7	10.0848	11.2574	7	45.1659	23.8238
8	10.5593	11.5192	8	46.1641	24.0856
9	11.0447	11.781	9	47.1731	24.3474
10	11.541	12.0428	10	48.193	24.6092
11	12.0483	12.3046	11	49.2238	24.871
4 ft.	12.5664	12.5664	8 ft.	50.2656	25.1328
1	13.0955	12.8282	1	51.3183	25.3946
2	13.6354	13.09	2	52.3818	25.6564
3	14.1863	13.3518	3	53.4563	25.9182
4	14.7481	13.6136	4	54.5417	26.18
5	15.3208	13.8754	5	55·638	26.4418
6	15.9043	14.1372	6	56.7451	26.7036
7	16.4989	14.499	7	57.8632	26.9654
8	17.1043	14.6608	8	58.9923	27.2272
9	17.7206	14.9226	9	60.1322	27.489
10	18.3478	15.1844	10	61.283	27.7508
11	18.9859	15.4462	11	62.4448	28.0126
			9 ft.	63.6174	28.2744

Table of Circumferences, Areas, Squares, Cubes, Square Root, Cube Root, from 1 to 10 Advancing by 1-16 etc.

Diam. or No.	Circumference.	Area.	Square.	Cube.	Square Root.	Cube Root.
1	3.14	.785	1.	1.	1.	1.
1-16	3.34	.886	1.13	1.19	1.031	1.020
1/8	3.53	.994	1.27	1.42	1.060	1.040
3-16	3.73	1.107	1.41	1.67	1.089	1.059
1/4	3.93	1.227	1.56	1.95	1.118	1.077
5-16	4.12	1.353	1.72	2.26	1.146	1.095
3/8	4.32	1.485	1.89	2.60	1.173	1.112
7-16	4.52	1.623	2.07	2.97	1.199	1.129
1/2	4.71	1.767	2.25	3.38	1.225	1.145
9-16	4.91	1.917	2.44	3.82	1.250	1.161
5/8	5.11	2.074	2.64	4.29	1.275	1.176
11-16	5.30	2.236	2.85	4.80	1.299	1.191
3/4	5.50	2.405	3.06	5.36	1.323	1.205
13-16	5.69	2.580	3.29	5.95	1.346	1.219
7/8	5.89	2.761	3.52	6.59	1.369	1.233
15-16	6.09	2.948	3.75	7.27	1.392	1.247
2	6.28	3.142	4.	8.	1.414	1.260
1-16	6.48	3.341	4.25	8.77	1.436	1.273
1/8	6.68	3.547	4.52	9.59	1.458	1.286
3-16	6.87	3.758	4.78	10.47	1.479	1.298
1/4	7.07	3.976	5.06	11.39	1.500	1.310
5.16	7.26	4.200	5.35	12.36	1.521	1.322
3/8	7.46	4.430	5.64	13.40	1.541	1.334
7-16	7.66	4.666	5.94	14.48	1.561	1.346
1/2	7.85	4.909	6.25	15.63	1.581	1.358
9-16	8.05	5.157	6.57	16.83	1.600	1.369
5/8	8.25	5.412	6.89	18.08	1.620	1.380
11-16	8.44	5.673	7.22	19.41	1.639	1.391
3/4	8.64	5.940	7.56	20.79	1.658	1.402
13-16	8.84	6.213	7.91	22.25	1.677	1.412
7/8	9.03	6.492	8.27	23.76	1.695	1.422
15-16	9.23	6.777	8.63	25.34	1.714	1.432
3	9.42	7.07	9.	27.	1.732	1.442
1/8	9.82	7.67	9.77	30.52	1.768	1.462
1/4	10.21	8.30	10.56	34.32	1.803	1.482
3/8	10.60	8.95	11.39	38.44	1.837	1.5
1/2	11.00	9.62	12.25	42.88	1.871	1.518
5/8	11.39	10.32	13.14	47.63	1.904	1.535
3/4	11.78	11.05	14.06	52.73	1.936	1.553
7/8	12.17	11.79	15.02	58.17	1.968	1.570
4	12.57	12.57	16.	64.	2.	1.587
1/4	13.35	14.19	18.06	76.78	2.061	1.619
1/2	14.14	15.90	20.25	91.13	2.121	1.651
3/4	14.92	17.72	22.56	107.16	2.179	1.681
5	15.71	19.63	25.	125.	2.236	1.710
1/4	16.49	21.64	27.56	144.70	2.291	1.738

Table of Circum. Areas, Squares, Etc,. (*Continued*).

Diam. or No.	Circum.	Areas.	Square.	Cube.	Square Root.	Cube Root.
5½	17.28	23.76	30.25	166.37	2.345	1.765
¾	18.06	25.07	33.06	190.11	2.398	1.792
6	18.85	29.29	36.	216.	2.449	1.817
¼	19.64	30.68	39.06	244.14	2.500	1.832
½	20.42	33.18	42.25	274.63	2.550	1.866
¾	21.21	35.78	45.56	307.55	2.599	1.890
7	21.99	38.48	49.	343.	2.646	1.913
¼	22.78	41.28	52.56	381.08	2.692	1.935
½	23.56	44.18	56.25	421.88	2.739	1.957
¾	24.35	47.17	60.06	465.48	2.784	1.979
8	25.13	50.26	64.	512.	2.828	2.
¼	25.92	53.46	68.06	561·52	2.872	2.021
½	26.70	56.75	72.25	614.12	2.915	2.041
¾	27.49	60.13	76.56	669.92	2.958	2.061
9	28.27	63.62	81.	729.	3.	2.080
¼	29.06	67.20	85.56	791.45	3.041	2.098
½	29.85	70.88	90.25	857.37	3.082	2.118
¾	30.63	74.66	95.06	926.86	3.122	2.136
10	31.41	78.54	100.	1000.	3.162	2.154

TABLE OF CIRCUMFERENCES, AREAS, SQUARES, CUBES, SQUARE ROOT AND CUBE ROOT.
Advancing by Decimals from .1 to 10.

Diam. or No.	Circum.	Areas.	Square.	Cube.	Square Root.	Cube Reot.
.1	.314	.00785	.01	.001	.316	.464
.2	.628	.0314	.04	.008	.447	.585
.3	.942	.0706	.09	.027	.548	.669
.4	1.26	.1256	.16	.064	.633	.737
.5	1.57	.1963	.25	.125	.707	.794
.6	1.88	.2827	.36	.216	.775	.843
.7	2.20	.3848	.49	.343	.837	.888
.8	2.51	.5026	.64	.512	.894	.928
.9	2.83	.6362	.81	.729	.949	.965
1.	3.14	.7854	1.	1.	1.	1.
.1	3.46	.9503	1.21	1.33	1.049	1.032
.2	3.77	1.131	1.44	1.73	1.095	1.063
.3	4.08	1.327	1.69	2.20	1.140	1.091
.4	4.39	1.539	1.96	2.74	1.183	1.119
.5	4.71	1.707	2.25	3.37	1.225	1.145
.6	5.02	2.011	2.56	4.10	1.265	1.170
.7	5.34	2.270	2.89	4.91	1.304	1.193
.8	5.65	2.545	3.24	5.83	1.342	1.216
.9	5.96	2.835	3.61	6.86	1.378	1.239
2.	6.28	3.142	4.	8.	1.414	1.260
.1	6.59	3.464	4.41	9.26	1.449	1.281
.2	6.91	3.801	4.84	10.65	1.483	1.301

TABLE OF CIRCUMFERENCES, AREAS, SQUARES, CUBES, SQUARE ROOT AND CUBE ROOT.

Advancing by Decimals from .1 to 10.

(TABLE CONTINUED).

Diam. or No.	Circum.	Areas.	Square.	Cube.	Square Root.	Cube Root.
2.3	7.22	4.155	5.29	12.17	1.517	1.320
.4	7.53	4.524	5.76	13.82	1.549	1.339
.5	7.85	4.909	6.25	15.63	1.581	1.357
.6	8.16	5.309	6.76	17.58	1.612	1.375
.7	8.48	5.726	7.29	19.68	1.643	1.392
.8	8.79	6.158	7.84	21.95	1.679	1.409
.9	9.11	6.605	8.41	24.39	1.703	1.426
3.	9.42	7.069	9.	27.	1.732	1.442
.2	10.05	7.548	10.24	32.77	1.789	1.474
.4	10.68	8.553	11.56	39.30	1.844	1.504
.6	11.30	10.18	12.96	46.66	1.897	1.533
.8	11.93	11.34	14.44	54.87	1.949	1.560
4,	12.56	12.57	16.	64.	2.	1.587
.2	13.19	13.85	17.64	74.09	2.049	1.613
.4	13.82	15.21	19.36	85.18	2.098	1.639
.6	14.45	16.62	21.16	97.34	2.145	1.663
.8	15.08	18.10	23.04	110.6	2.191	1.687
5.	15.70	19.63	25.	125.	2.236	1.710
.2	16.33	21.24	27.04	140.6	2.280	1.732
.4	16.96	22.90	29.16	157.5	2.324	1.754
.6	17.59	24.63	31.36	175.6	2.366	1.776
.8	18.22	26.42	33.64	195.1	2.408	1.797
6.	18.84	28.27	36.	216.	2.449	1.817
.2	19.47	30.19	38.44	238.3	2.490	1.837
.4	20.10	32.17	40.96	262.1	2·530	1.856
.6	20.73	34.21	43.56	287.5	2.569	1.876
.8	21.36	36.32	46.24	314.4	2.608	1.895
7.	21.99	38.48	49.	343.	2.646	1.913
.2	22.61	40.72	51.84	373.2	2.683	1.931
.4	23.24	43.01	54.76	405.2	2.720	1.949
.6	23.87	45.36	57.76	439.	2.757	1.966
.8	24.50	47.78	60.84	474.6	2.793	1.983
8.	25.13	50.27	64.	512.	2.828	2.
.2	25.76	52.81	67.24	551.4	2.864	2.017
.4	26.38	55.42	77.56	592.7	2.898	2.033
.6	27.01	58.09	73.96	636.1	2.933	2.049
.8	27.64	60.82	74.44	681.5	2.966	2.065
9.	28.27	63.62	81.	729.	3.	2.080
.2	28.90	66.48	84.64	778.7	3.033	2.095
.4	29.53	69.40	88.36	830.6	3.066	2.110
.6	30.15	72.38	92.16	884.7	3.098	2.125
.8	30.78	75.43	96.04	941.2	3.130	2.140
10.	31.41	78.54	100.	1000.	3.162	2,154

Tables of Diameters, Areas, Circumferences of Circles, Squares, Cubes, Square Root, Cube Root, and Reciprocals of Numbers (From 1 to 250).

No.	Cir.	Areas.	Sq're.	Cube.	S.Root.	C.R't.	Recip.
1	3.14	0.79	1	1	1.000	1.000	1.00000
2	6.28	3.14	4	8	1.414	1.260	.50000
3	9.42	7.07	9	27	1.732	1.442	.33334
4	12.57	12.57	16	64	2.000	1.587	.25000
5	15.71	19.62	25	125	2.236	1.710	.20000
6	18.85	28.27	36	216	2.450	1.817	.16667
7	21.99	38.48	49	343	2.646	1.913	.14285
8	25.13	50.27	64	512	2.828	2.000	.12500
9	28.27	63.62	81	729	3.000	2.080	.11112
10	31.41	78.54	100	1000	3.162	2.154	.10000
11	34.56	95.03	121	1331	3.317	2.224	.09091
12	37.70	113.10	144	1728	3.464	2.289	.08333
13	40.84	132.73	169	2197	3.605	2.351	.07692
14	43.98	153.94	196	2744	3.741	2.410	.07142
15	47.12	176.72	225	3375	3.872	2.466	.06667
16	50.27	201.06	256	4096	4.000	2.519	.06250
17	53.41	226.98	289	4913	4.123	2.571	.05882
18	56.55	254.47	324	5832	4.242	2.620	.05556
19	59.69	283.53	361	6859	4.358	2.668	.05263
20	62.82	314.15	400	8000	4.472	2.714	.05000
21	65.97	346.36	441	9261	4.582	2.758	.04761
22	69.12	380.13	484	10648	4.690	2.802	.04545
23	72.26	415.48	529	12167	4.795	2.843	.04347
24	75.40	452.39	576	13824	4.898	2.884	.04167
25	78.54	490.87	625	15625	5.000	2.924	.04000
26	81.68	530.93	676	17576	5.099	2.962	.03846
27	84.82	572.56	729	19683	5.196	3.000	.03703
28	87.96	615.75	784	21952	5.291	5.036	.03571
29	91.11	660.52	841	24389	5.385	3.072	.03448
30	94.25	706.86	900	27000	5.477	3.107	.03334
31	97.36	754.77	961	29791	5.567	3.141	.03225
32	100.53	804.25	1024	32768	5.657	3.174	.03125
33	103.67	855.30	1089	35937	5.744	3.207	.03031
34	106.82	907.92	1156	39304	5.830	3.239	.02941
35	109.96	962.11	1225	42875	5.916	3.271	.02857
36	113.10	1017.88	1296	46656	6.000	3.301	.02666
37	116.24	1075.21	1369	50653	6.082	3.332	.02702
38	119.38	1134.11	1444	54872	6.164	3.361	.02631
39	122.52	1194.59	1521	59319	6.244	3.391	.02564
40	125.66	1256.64	1600	64000	6.324	3.419	.02500
41	128.81	1320.25	1681	68921	6.403	3.448	.02439
42	131.95	1385.44	1764	74088	6.480	3.476	.02380
43	135.09	1452.20	1849	79507	6.557	3.503	.02325
44	138.23	1520.53	1936	85184	6.633	3.530	.02272
45	141.37	1590.43	2025	91125	6.708	3.556	.02222
46	144.51	1661.90	2116	97336	6.782	3.583	.02173
47	147.66	1734.94	2209	103823	6.856	3.609	.02127
48	150.80	1809.56	2304	110592	6.928	3.634	.02083
49	153.94	1885.74	2401	117649	7.000	3.659	.02040
50	157.08	1963.50	2500	125000	7.071	3.684	.02000

Tables of Diameters, Areas, Circumfer'ces, etc., (Continued).

No.	Cir.	Areas.	Sq're.	Cube.	S.Root.	C.R't.	Recip.
51	160.22	2042.82	2601	132651	7.141	3.708	.01960
52	163.36	2123.72	2704	140608	7.211	3.732	.01923
53	166.50	2206.18	2809	148877	7.280	3.756	.01886
54	169.65	2290.22	2916	156464	7.348	3.779	.01851
55	172.79	2375.83	3025	166375	7.416	3.802	.01818
56	175.93	2463.01	3136	175616	7.483	3.825	.01785
57	179.07	2551.76	3249	185193	7.549	3.848	.01754
58	182.21	2642.08	3364	195112	7.615	3.870	.01724
59	185.35	2733.97	3481	205379	7.681	3.892	.01694
60	188.50	2827.43	3600	216000	7.746	3.915	.01667
61	191.64	2922.47	3721	226981	7.810	3.936	.01639
62	194.78	3019.07	3844	238328	7.874	3.957	.01612
63	196.94	3117.25	3969	250047	7.936	3.979	.01587
64	201.06	3216.99	4096	262144	8.000	4.000	.01562
65	204.20	3318.31	4225	274625	8.062	4.020	.01538
66	207.35	3421.19	4356	287496	8.124	4.041	.01515
67	210.49	3525.65	4489	300763	8.185	4.061	.01492
68	213.63	3631.68	4624	314432	8.246	4.081	.01470
69	216.77	3739.28	4761	328509	8.306	4.101	.01449
70	219.91	3848.45	4900	343000	8.367	4.121	.01428
71	223.05	3959.19	5041	357911	8.426	4.140	.01408
72	226.19	4071.50	5184	373248	8.485	4.160	.01389
73	229.34	4185.09	5329	399017	8.544	4.179	.01369
74	234.48	4300.84	5476	405224	8.602	4.198	.01351
75	235.62	4417.86	5625	421875	8.660	4.217	.01333
76	238.76	4536.46	5776	438976	8.717	4.235	.01315
77	241.90	4656.63	5929	456533	8.775	4.254	.01298
78	245.04	4778.36	6084	474552	8.831	4.272	.01282
79	248.19	4901.67	6241	493039	8.888	4.290	.01265
80	251.33	5026.55	6400	512000	9.944	4.309	.01250
81	254.47	5153.00	6561	531441	9.000	4.326	.01234
82	257.61	5281.02	6724	551368	9.055	4.344	.01219
83	260.75	5410.61	6889	571787	9.110	4.362	.01204
84	263.89	5541.77	7056	592704	9.165	4.379	.01190
85	267.04	5674.50	7225	614125	9.219	4.396	.01176
86	270.18	5808.80	7326	636056	9.273	4.414	.01162
87	273.32	5944.68	7569	658503	9.327	4.431	.01149
88	276.46	6082.12	7744	681472	9.380	4.447	.01136
89	279.60	6221.44	7921	704969	9.433	4.461	.01123
90	282.74	6361.72	8100	729000	9.487	4.481	.01111
91	285.89	6503.88	8281	753571	9.539	4.497	.01098
92	289.03	6647.61	8464	778688	9.591	4.514	.01086
93	292.17	6792.91	8649	804357	9.643	4.530	.01075
94	297.31	6939.78	8836	830584	9.695	4.546	.01063
95	298.45	7088.22	9025	857375	9.746	4.562	.01052
96	301.59	7238.23	9216	884736	9.797	4.578	.01041
97	304.73	7389.81	9409	912673	9.848	4.594	.01030
98	307.87	7542.96	9604	941192	9.899	4.610	.01020
99	311.02	7697.69	9801	970299	9.949	4.626	.01010
100	314.16	7853.98	10000	1000000	10.000	4.642	.01000

Tables of Diameters, Areas, Circumfer'ces, etc., (Continued).

No.	Cir.	Areas.	Sq're.	Cube.	S.Root.	C. R't.	Recip.
101	317.30	8011.85	10201	1030301	10.049	4.657	.00990
102	320.44	8171.28	10404	1061208	10.099	4.672	.00980
103	323.58	8332.29	10609	1092727	10.148	4.687	.00970
104	326.73	8494.87	10816	1124864	10.198	4.702	.00961
105	329.87	8659.01	11025	1157625	10.246	4.717	.00952
106	333.01	8824.73	11236	1191016	10.295	4.732	.00943
107	336.15	8992.02	11449	1225043	10.344	4.747	.00933
108	339.29	9160.88	11664	1259712	10.392	4.762	.00925
109	342.43	9331.32	11881	1295029	10.440	4.776	.00917
110	345.58	9503.32	12100	1331000	10.488	4.791	.00909
111	348.72	9676.89	12321	1367631	10.536	4.806	.00900
112	351.86	9852.03	12544	1404928	10.583	4.820	.00892
113	355.00	10028.75	12769	1442897	10.630	4.834	.00884
114	358.14	10207.03	12996	1481544	10.677	4.848	.00877
115	361.28	10386.89	13225	1520875	10.723	4.862	.00869
116	364.42	10568.32	13456	1560896	10.770	4.876	.00862
117	367.56	10751.32	13689	1601613	10.816	4.890	.00854
118	370.70	10935.88	13924	1643032	10.862	4.904	.00847
119	373.85	11122.02	14161	1685159	10.908	4.918	.00840
120	376.99	11309.73	14400	1728000	10.954	4.932	.00834
121	380.13	11499.10	14641	1771561	11.000	4.946	.00826
122	383.27	11689.87	14884	1815848	11.045	4.959	.00819
123	386.41	11882.29	15129	1860867	11.090	4.973	.00813
124	389.56	12076.28	15376	1906624	11.135	4.986	.00806
125	392.70	12271.85	15625	1953125	11.180	5.000	.00800
126	395.84	12468.98	15876	2000376	11.224	5.013	.00793
127	398.98	12667.69	16129	2048383	11.269	5.026	.00787
128	402.12	12867.96	16384	2097152	11.314	5.039	.00781
129	405.27	13069.81	16641	2146689	11.357	5.052	.00775
130	408.41	13273.23	16900	2197000	11.401	5.065	.00769
131	411.55	13478.22	17161	2248091	11.445	5.078	.00763
132	414.69	13684.78	17424	2299968	11.489	5.091	.00757
133	417.83	13892.91	17689	2352637	11.532	5.104	.00751
134	420.97	14102.61	17956	2406104	11.575	5.117	.00746
135	424.12	14313.88	18225	2460375	11.618	5.129	.00740
136	427.26	14526.72	18496	2515456	11.661	5.142	.00735
137	430.40	14741.14	18769	2571353	11.704	5.155	.00729
138	433.54	14957.12	19044	2600872	11.747	5.166	.00724
139	436.68	15174.68	19321	2685619	11.789	5.180	.00719
140	439.82	15393.81	19600	2744000	11.832	5.192	.00714
141	442.96	15614.50	19881	2803221	11.874	5.204	.00709
142	446.11	15836.77	20164	2863288	11.916	5.217	.00704
143	449.25	16060.61	20449	2924207	11.958	5.229	.00699
144	452.39	16286.02	20736	2985984	12.000	5.241	.00694
145	455.53	16513.00	21025	3048625	12.041	5.253	.00689
146	458.67	16741.55	21316	3112136	12.083	5.265	.00684
147	461.81	16971.67	21609	3176523	12.124	5.277	.00680
148	464.96	17203.36	21904	3241792	12.165	5.289	.00675
149	468.10	17436.62	22201	3307949	12.206	5.301	.00671
150	471.24	17671.46	22500	3375000	12.247	5.313	.00667

Tables of Diameters, Areas, Circumfer'ces, etc., (Continued).

No.	Cir.	Areas.	Sq're.	Cube.	S.Root.	C. R't.	Recip.
151	474.38	17907.56	22801	3442951	12.288	5.325	.00662
152	477.52	18145.84	23104	3511808	12.328	5.336	.00657
153	480.66	18385.39	23409	3581577	12.369	5.348	.00653
154	483.81	18626.50	23716	3652264	12.409	5.360	.00649
155	486.95	18869.19	24025	3723875	12.449	5.371	.00645
156	490.09	19113.45	24336	3796416	12.489	5.383	.00641
157	493.23	19359.28	24649	3869893	12.529	5.394	.00636
158	496.37	19606.68	24964	3944312	12.569	5.406	.00632
159	499.51	19855.65	25281	4019679	12.609	5.417	.00628
160	502.65	20106.19	25600	4096000	12.649	5.428	.00625
161	505.80	20358.31	25921	4173281	12.688	5.440	.00621
162	508.94	20611.99	26244	4251528	12.727	5.451	.00617
163	512.08	20867.19	26569	4330747	12.767	5.462	.00613
164	515.22	21124.07	26896	4410944	12.806	5.473	.00609
165	518.36	21382.47	27225	4492125	12.845	5.484	.00606
166	521.50	21642.43	27556	4574296	12.884	5.495	.00602
167	524.65	21904.0	27889	4657463	12.922	5.506	.00598
168	527.79	22167.1	28224	4741632	12.961	5.517	.00595
169	530.93	22431.8	28561	4826809	13.000	5.528	.00591
170	534.07	22698.0	28900	4913000	13.038	5.539	.00588
171	537.21	22965.8	29240	5000211	13.076	5.550	.00584
172	540.36	23235.2	29584	5088448	13.114	5.561	.00581
173	543.50	23506.2	29929	5177717	13.152	5.572	.00578
174	546.64	23778.7	30276	5268024	13.190	5.582	.00574
175	549.78	24052.8	30625	5359375	13.228	5.593	.00571
176	552.92	24328.5	30976	5451776	13.266	5.604	.00568
177	556.06	24605.7	31329	5545233	13.304	5.614	.00564
178	559.20	24884.6	31684	5639752	13.341	5.625	.00561
179	562.34	25164.9	32041	5735339	13.379	5.635	.00558
180	565.49	25446.9	32400	5832000	13.416	5.646	.00555
181	568.63	25730.4	32761	5929741	13.453	5.656	.00552
182	571.77	26015.5	33124	6028578	13.490	5.667	.00549
183	574.91	26302.2	33489	6128487	13.527	5.677	.00546
184	578.05	26590.4	33856	6229504	13.564	5.687	.00543
185	581.19	26880.3	34225	6331625	13.601	5.698	.00540
186	584.34	27171.6	34596	6434856	13.638	5.708	.00537
187	587.48	27464.6	34969	6539203	13.674	5.718	.00534
188	590.62	27759.1	35344	6644672	13.711	5.728	.00531
189	593.76	28055.2	35721	6751269	13.747	5.738	.00529
190	596.90	28352.9	36100	6859000	13.784	5.748	.00526
191	600.04	28652.1	36481	6967871	13.820	5.758	.00523
192	603.19	28952.9	36864	7077888	13.856	5.768	.00520
193	606.33	29255.3	37249	7189057	13.892	5.778	.00518
194	609.47	29559.2	37636	7301384	13.928	5.788	.00515
195	612.61	29864.8	38025	7414875	13.964	5.798	.00512
196	615.75	30171.9	38416	7529536	14.000	5.808	.00510
197	618.89	30480.5	38809	7645373	14.035	5.818	.00507
198	622.04	30790.7	39204	7762392	14.071	5.828	.00505
199	625.18	31102.6	39601	7880599	14.106	5.838	.00502
200	628.32	31415.9	40000	8000000	14.142	5.848	.00500

Tables of Diameters, Areas, Circumfer'ces, etc., (Continued).

No.	Cir.	Areas.	Sq're.	Cube.	S.Root.	C. R't.	Recip.
201	631.46	31730.9	40401	8120601	14.177	5.857	.00497
202	634.60	32047.4	40804	8242408	14.212	5.867	.00495
203	637.74	32365.5	41209	8365427	14.247	5.877	.00492
204	640.88	32685.1	41616	8489664	14.282	5.886	.00490
205	644.03	33006.4	42025	8615125	14.317	5.896	.00487
206	647.17	33329.2	42436	8741816	14.352	5.905	.00485
207	650.31	33653.5	42849	8869743	14.387	5.915	.00483
208	653.45	33979.5	43264	8998912	14.422	5.924	.00480
209	656.59	34307.0	43681	9129329	14.456	5.934	.00478
210	659.63	34636.1	44100	9261000	14.491	5.943	.00476
211	662.87	34966.7	44521	9393931	14.525	5.953	.00473
212	666.01	35298.9	44944	9528128	14.560	5.962	.00471
213	669.16	35632.7	45369	9663597	14.594	5.972	.00469
214	672.30	35968.1	45796	9800344	14.628	5.981	.00467
215	675.44	36305.0	46225	9938375	14.662	5.990	.00465
216	678.58	36643.5	46656	10077696	14.696	6.000	.00462
217	681.73	36983.6	47089	10218313	14.730	6.009	.00460
218	684.87	37325.3	47525	10360232	14.764	6.018	.00458
219	688.01	37668.5	47961	10503459	14.798	6.027	.00456
220	691.15	38013.3	48400	10648000	14.832	6.036	.00454
221	694.29	38359.6	48841	10793861	14.866	6.045	.00452
222	697.43	38707.6	49284	10941048	14.899	6.055	.00450
223	700.57	39057.1	49729	11089567	14.933	6.064	.00448
224	703.71	39408.1	50176	11239424	14.966	6.073	.00446
225	706.86	39760.8	50625	11390625	15.000	6.082	.00444
226	710.00	40115.0	50876	11543176	15.033	6.091	.00442
227	713.14	40470.8	51529	11697083	15.066	6.100	.00440
228	716.28	40828.1	51984	11852352	15.099	6.109	.00438
229	719.42	41187.1	52441	12008989	15.132	6.118	.00436
230	722.57	41547.6	52900	12167000	15.165	6.126	.00434
231	725.71	41909.6	53361	12326391	15.198	6.135	.00432
232	728.85	42273.3	53824	12487168	15.231	6.144	.00431
233	731.99	42638.5	54289	12649336	15.264	6.153	.00429
234	735.13	43005.3	54756	12812904	15.297	6.162	.00427
235	738.27	43373.6	55225	12977874	15.329	6.171	.00425
236	741.42	43743.5	55696	13144256	15.362	6.179	.00423
237	744.56	44145.8	56169	13312053	15.394	6.188	.00421
238	747.70	44488.1	56644	13481272	15.427	6.197	.00420
239	750.84	44862.7	57121	13651919	15.459	6.205	.00418
240	753.98	45238.9	57600	13824000	15.491	6.214	.00416
241	757.12	45616.7	58081	13997521	15.524	6.223	.00414
242	760.27	45996.1	58564	14172488	15.556	6.231	.00413
243	763.41	46377.0	59049	14348907	15.588	6.240	.00411
244	766.55	46759.5	59536	14526784	15.620	6.248	.00409
245	769.69	47143.5	60025	14706125	15.652	6.257	.00408
246	772.83	47529.2	60516	14886936	15.684	6.265	.00406
247	775.96	47916.4	61009	15069223	15.716	6.274	.00404
248	779.11	48305.1	61504	15252992	15.748	6.282	.00403
249	782.26	48695.5	62001	15438249	15.779	6.291	.00401
250	785.40	49087.4	62500	15625000	15.811	6.299	.00400

TABLE of AREAS of SQUARES and CIRCLES, SIDE of SQUARE both in DECIMALS and FRACTIONS.

From 1-16 to 12.

Diam.	Area of □ in Ins,	Area in ○ Ins.	Side of Square.	
			In decim'ls.	In fracti'ns.
$\frac{1}{16}$	.0039	.0031	.0553	$\frac{1}{16}$ in.
$\frac{1}{8}$	.0156	.0123	.1108	$\frac{15}{128}$ "
$\frac{3}{16}$	.0351	.0276	.1662	$\frac{21}{128}$ "
$\frac{1}{4}$	.0625	.0491	.2216	$\frac{7}{32}$ "
$\frac{5}{16}$	.0976	.0767	.2769	
$\frac{3}{8}$	.1406	.1104	.3325	$\frac{21}{64}$ "
$\frac{7}{16}$	.1914	.1503	.3877	
$\frac{1}{2}$	.25	.1963	.4431	$\frac{7}{16}$ "
$\frac{9}{16}$	.3166	.2485	.4985	$\frac{1}{2}$ "
$\frac{5}{8}$	.3906	.3068	.5539	$\frac{35}{64}$ "
$\frac{11}{16}$	.4727	.3712	.6093	$\frac{77}{128}$ "
$\frac{3}{4}$	.5625	.4418	.6646	$\frac{21}{32}$ "
$\frac{13}{16}$	.6603	.5185	.72	
$\frac{7}{8}$	.7656	.6013	.7754	$\frac{49}{64}$ "
$\frac{15}{16}$	.879	.6903	.8308	
1	1.	.7854	.8862	$\frac{7}{8}$ "
$\frac{1}{16}$	1.129	.8868	.9416	"
$\frac{1}{8}$	1.266	.994	.997	$\frac{63}{64}$ "
$\frac{3}{16}$	1.409	1.107	1.052	
$\frac{1}{4}$	1.562	1.227	1.108	$1\frac{7}{64}$ "
$\frac{5}{16}$	1.723	1.353	1.163	
$\frac{3}{8}$	1.891	1.485	1.218	$1\frac{7}{32}$ "
$\frac{7}{16}$	2.067	1.623	1.274	
$\frac{1}{2}$	2.25	1.767	1.329	$1\frac{21}{64}$ "
$\frac{9}{16}$	2.439	1.916	1.385	
$\frac{5}{8}$	2.641	2.764	1.44	$1\frac{7}{16}$ "
$\frac{11}{16}$	2.864	2.25	1.495	
$\frac{3}{4}$	3.063	2.405	1.551	$1\frac{35}{64}$ "
$\frac{13}{16}$	3.287	2.581	1.606	$1\frac{39}{64}$ "
$\frac{7}{8}$	3.516	2.761	1.661	$1\frac{21}{32}$ "
$\frac{15}{16}$	3.752	2.948	1.717	$1\frac{23}{32}$ "
2	4.	3.142	1.772	$1\frac{25}{32}$ "
$\frac{1}{8}$	4.516	3.546	1.883	
$\frac{1}{4}$	5.062	3.976	1.994	$1\frac{63}{64}$ "
$\frac{3}{8}$	5.640	4.430	2.105	$2\frac{7}{64}$ "
$\frac{1}{2}$	6.25	4.908	2.215	$2\frac{7}{32}$ "
$\frac{5}{8}$	6.889	5.412	2.326	$2\frac{21}{64}$ "
$\frac{3}{4}$	7.56	5.939	2.437	$2\frac{7}{16}$ "
$\frac{7}{8}$	8.264	6.492	2.548	$2\frac{35}{64}$ "
3	9.	7.069	2.659	$2\frac{21}{32}$ "
$\frac{1}{8}$	9.764	7.67	2.769	$2\frac{25}{32}$ "
$\frac{1}{4}$	10.561	8.296	2.88	$2\frac{7}{8}$ "
$\frac{3}{8}$	11.388	8.946	2.991	$2\frac{63}{64}$ "
$\frac{1}{2}$	12.25	9.621	3.102	$3\frac{7}{64}$ "

TABLE of AREAS of SQUARES and CIRCLES, SIDE of SQUARE both in DECIMALS and FRACTIONS.

(*Continued*).

Diam.	Area of □ in Ins,	Area in ○ Ins.	Side of Square. In decim'ls.	Side of Square. In fracti'ns.
$3\frac{5}{8}$	13.138	10.321	3.213	$3\frac{7}{32}$ in.
$\frac{1}{4}$	14.065	11.045	3.323	$3\frac{21}{64}$ "
$\frac{3}{4}$	15.01	11.793	3.434	$3\frac{7}{16}$ "
$\frac{7}{8}$	16.	12.566	3.545	$3\frac{35}{64}$ "
4	17.012	13.364	3.656	$3\frac{21}{32}$ "
$\frac{1}{8}$	18.058	14.186	3.766	$3\frac{49}{64}$ "
$\frac{1}{4}$	19.141	15.033	3.877	$3\frac{7}{8}$ "
$\frac{3}{8}$	20.254	15.904	3.987	$3\frac{63}{64}$ "
$\frac{1}{2}$	21.385	16.8	4.098	$4\frac{7}{64}$ "
$\frac{5}{8}$	22.556	17.721	4.208	$4\frac{7}{32}$ "
$\frac{3}{4}$	23.748	18.655	4.321	$4\frac{21}{64}$ "
$\frac{7}{8}$	25.	19.635	4.431	$4\frac{7}{16}$ "
5	26.26	20.629	4.542	$4\frac{35}{64}$ "
$\frac{1}{8}$	27.557	21.648	4.653	$4\frac{21}{32}$ "
$\frac{1}{4}$	28.884	22.69	4.764	$4\frac{49}{64}$ "
$\frac{3}{8}$	30.25	23.758	4.875	$4\frac{7}{8}$ "
$\frac{1}{2}$	31.641	24.851	4.985	$4\frac{63}{64}$ "
$\frac{5}{8}$	33.06	25.967	5.096	$5\frac{3}{32}$ "
$\frac{3}{4}$	34.516	27.109	5.317	$5\frac{13}{64}$ "
$\frac{7}{8}$	36.	28.274	5.207	$5\frac{21}{64}$ "
6	39.063	30.679	5.538	$5\frac{17}{32}$ "
$\frac{1}{4}$	42.25	33.183	5.76	$5\frac{3}{4}$ "
$\frac{1}{2}$	45.562	35.785	5.982	$5\frac{63}{64}$ "
$\frac{3}{4}$	49.	38.485	6.203	$6\frac{7}{64}$ "
7	52.562	41.282	6.425	$6\frac{27}{64}$ "
$\frac{1}{4}$	56.25	44.179	6.646	$6\frac{41}{64}$ "
$\frac{1}{2}$	60.062	47.173	6.868	$6\frac{55}{64}$ "
$\frac{3}{4}$	64.	50.266	7.09	$7\frac{3}{32}$ "
8	68.062	53.456	7.311	$7\frac{5}{16}$ "
$\frac{1}{4}$	72.25	56.745	7.533	$7\frac{33}{64}$ "
$\frac{1}{2}$	76.562	60.132	7.754	$7\frac{49}{64}$ "
$\frac{3}{4}$	81.	63.617	7.976	$7\frac{63}{64}$ "
9	85.563	67.201	8.198	$8\frac{13}{64}$ "
$\frac{1}{4}$	90.25	70.882	8.419	$8\frac{27}{64}$ "
$\frac{1}{2}$	95.062	74.662	8.641	$8\frac{41}{64}$ "
$\frac{3}{4}$	99.98	78.54	8.862	$8\frac{55}{64}$ "
10	105.04	82.516	9.084	$9\frac{11}{128}$ "
$\frac{1}{4}$	110.23	86.59	9.304	$9\frac{19}{64}$ "
$\frac{1}{2}$	115.55	90.763	9.527	$9\frac{37}{64}$ "
$\frac{3}{4}$	121.	95.033	9.748	$9\frac{3}{4}$ "
11	126.54	99.402	9.975	10 "
$\frac{1}{4}$	132.22	103.87	10.19	$10\frac{13}{64}$ "
$\frac{1}{2}$	138.06	108.43	10.42	$10\frac{13}{31}$ "
$\frac{3}{4}$	144.	113.1	10.64	$10\frac{11}{64}$ "
12				

ELECTRICITY.

Conductors.	Non-Conductors.
Most Perfect.	*Less Perfect.*
All known Metals.	Ice at 0° Farht.
Well-burned Charcoal.	Dry Vegetable substances.
Plumbago.	Dry Animal substances generally.
Burning Gaseous Matter or flame.	Parchment, Leather, Feathers.
Smoke.	Baked Wood. [ces.
Less Perfect.	Oil and Fatty substan-
Concentrated Acids.	Silk.
Dilute. Acids	*Most Perfect.*
Saline Fluids.	Fur and Hair.
Living Animals.	Dry gases including air.
" Vegetables.	Pure Steam of high-pressure.
Wood, in the ordinary state	Glass and all [vitrifactions.
Snow, and Ice from 32° to 0°	Diamonds and transparent Gems.
Water.	Talc.
Imperfect.	Amber.
Common Earth and Stone.	All Resinous Bodies.
Dry Chalk and Lime.	Brimstone.
Marble and Porcelain.	Shell-lac.
Paper.	Bees-Wax.
Alkaline matter.	
Aqueous vapor.	

The following is a short list of substances which may be used to receive the deposit of metal.

Carbon.	In all metallic solutions, acid, neutral, or alkaline.		
Platinum.	do.	do.	do.
Gold.	do.	do.	do.
Palladium.	do.	do.	do.
Silver.	In all alkaline, in all but the preceding, saline and acid.		
Copper.	do.	do.	do.
Lead.	do.	do.	do.
Bismuth.	do.	do.	do.
Antimony.	do.	do.	do.
Tin.	do.	do.	do.
Iron.	do.	do.	do.
Zinc.	In some alkaline and acid.		

NON-METALLIC SUBSTANCES.

In all saline or acid solutions; but not in alkaline. Sealing Wax, White Wax, Bees Wax and Rosin, Stearine, Spermaceti, Plaster of Paris prepared, some Animal substances, Most vegetables substances.

DEPOSITION of METALS.

Gold Baths.

FOR SILVER, COPPER, or ALLOYS RICH IN THESE.

Distilled water,	1 gallon.
Phosphate of soda, cryst,	9½ oz.
Bisulphite of soda,	1 3-5 "
Cyanide of potassium, pure,	1-6 "
Gold Chloride,	160 grains.

Dissolve in a portion of the water, heated, phosphate of soda. Dissolve in another portion of the water the bisulphite of soda and cyanide of potassium. Dissolve the gold choloride in the remaining water, stir the solution slowly into the cold phosphate of soda solution, and finally add the solution of cyanide bisulphite. The bath, now ready for use, should be colorless. Used at a temperature of from 120°to 175° Fah.

BATH FOR IRON OR STEEL UNCOATED.

Distilled water	1 gallon.
Phosphate of Soda.	7 4-5 oz.
Bisulphite of Soda.	2 "
Cyanide of potassium, pure.	3-5 dr.
Gold chloride.	160 grains.

Dissolve as before. Heat to 175° or 180° Fah. Pass the second metal through the hot potash, then through dilute muriatic acid (acid 1, water 15), brush, and connect at once. Requires a very intense current at first.

COLD ELECTRIC-GILDING BATH.

Water, distilled.	1 gallon.
Potassium Cyanide, pure.	3 1-5 oz.
Gold Chloride.	3 1-10 "

Dissolve the Cyanide in a part of the water, then gradually add the gold chloride dissolved in the remainder. Boil for half an hour before using. (Use cold).

ZINC BATH.

Zinc is used for the preservation of iron, by electro-deposition. The iron is first rendered perfectly clean and free from oxide, by placing it in a bath of heated sulphuric acid and water; then in a cold solution of sulphate of zinc. The positive pole of a galvanic battery is attached to a zinc plate, and the negative to the iron to be covered; the pure metal is deposited, and the zinc and the iron are amalgamated.

PLATINUM.

The best solution to be employed is the nitro-muriate of platinum, to which sufficient soda is added to render it neutral. The object to be coated should be smooth, and thoroughly cleansed by potash before the process is com-

menced. Having proceeded thus far, and the solution of platinum being ready, a fine platinum wire in connection with the silver or positive pole of the battery, must be placed so as to dip into the solution, but must not be immersed beyond a very short distance. The object to be platinated is now ready for connection with the zinc or negative pole of the battery; after this is effected it is to be dipped in the solution.

SILVER BATH.

For electro-silver plating the double salt of silver and potassium cyanide is almost universally employed. The following are the proportions viz:

Water (soft),	1 gallon.
Cyanide of Potassium (pure),	8 ounces.
Nitrate of Silver,	5¼ "

Dissolve the nitrate of silver in a sufficient quantity of pure water (soft), and add to it gradually, with constant stirring hydrocyanic (prussic) acid until all the silver has been precipitated as cyanide, which may be known by the formation of no cloud in a portion of the clear liquid when a drop of the acid is added to it, avoid adding an excess of the acid. Throw the precipitate upon a fine cotton cloth filter, and as the liquid runs through wash the precipitate on the cloth several times with pure water. Dissolve the cyanide of potassium in the water, and stir in the cyanide of silver carefully removed from the cloth. If it does not dissolve in the liquid entirely, add more cyanide of potassium until it does, stirring continually. Let the impurities settle, and the bath is ready for use.

NICKEL BATH.

The nickel salts commonly used are the nickel ammonium sulphate (called double sulphate) and the corresponding chloride, Other salts, such as the nickel potassium cyanide, the acetate and sulphate, have been used, but not successfully as these.

The double sulphate bath may be prepared by dissolving three-fourths of a pound of the salt in each gallon of water, (soft). It should be kept neutral and up to about six degrees of hydrometer.

The double chloride bath requires about four ounces of the salt per gallon, and works better slightly acid, the tendency in working being towards alkalinity. The bath should be filtered when freshly prepared, and should be kept in a separate room, or at least away from the apartment in which the buffing or polishing is performed, to avoid contamination by dust as much as possible. Exposed to the air the bath (the water) evaporates, and the water thus lost must be replaced from time to time. Keep out dust as much as possible. It is well to cover the bath when not in use.

BRASS BATH.

Where the ordinary cheap commercial cyanide is employed the following answers very well:

Sulphate of Copper,	4 oz.
Sulphate of Zinc,	4 to 5 "
Water,	1 gal.

Dissolve and precipitate with 30 ounces of carbonate of soda; allow to settle, and decant the clear liquid, and wash the precipitate several times with fresh water—after as many settling add to the washed precipitates:

Carbonate of Soda,	15 oz.
Bisulphite of Soda,	7½ "
Water,	1 gal.

Stir to effect solution of these last two, then stir in ordinary cyanide of potassium until the liquid becomes clear and colorless. Filter if much iron or iron oxide (derived from impure zinc salt and cyanide) remains suspended in the liquid. An additional half ounce or so of the cyanide improves the conductivity of the solution.

COLD BRASS BATH FOR ALL METALS.

Carbonate of Copper (recently prepared).	2 oz.
Corbonate of Zinc, " "	2 oz.
Carbonate Soda	4 oz.
Bisulphite of Soda,	4 oz.
Cyanide of Potassium (pure),	4 oz.
Arsenious Acid,	1-20 oz.
Water,	1 gal.

Filter if necessary.

The arsenious acid is added to brighten the deposit, an excess is apt to give the metal a grayish-white color.

STEEL BATH.

In order to render copper-plates, which are used in printing, more durable, they can be covered with an electrolytic deposit of iron, which possesses an unusual degree of hardness, almost superior to steel. The salt usually employed has been the double sulphate of iron and ammonia. Professor Böttger, who first used this combination of salts in the process, has recently devised an improvement in the bath employed. He dissolves ten parts of ferrocyanide potassium (yellow prussiate of potash) and twenty parts of the double tartrate of soda and potash (Rochelle salts) in 200 parts of water, and to this he adds three parts of persulphate of iron dissolved in fifty parts of water. A large precipitate of prussian blue is formed; to the whole is added, drop by drop, with constant stirring, a solution of caustic soda until the blue precipitate entirely disappears, leaving a perfectly clear, light yellow liquid, which is now ready for use.

TIN BATH.

The following is one of the best solutions for plating with tin by the battery process;

Potassium pyrophosphate,	12 oz.
Protochloride of tin,	4½"
Water,	20 "

The anode or feeding plate used in this bath consists of pure Banca tin. A moderately strong battery is required, and the work is finished by scratch-brushing.

COPPER BATH FOR ELECTROTYPING.

Dissolve sulphate of copper in water until the solution registers 15° by an acid hydrometer, then add enough sulphuric acid to make the hydrometer register 18°. This bath need not be filtered. It should be stirred about once or twice a week when using.

COPPER:—Cold Bath for Iron, Steel, Etc.

Acetate of Copper,	3 oz.
Carbonate of Soda,	6 1-5"
Bisulphite of Soda,	3 1-5"
Cyanide of Potassium,	3¼ "
Water,	1 gallon.
Aqua Ammonia,	2 1-5 fl oz.

WARM BATH.

Acetate of Copper,	3 1-5 oz.
Carbonate of Soda,	3 1-5 "
Bisulphite of Soda,	1 1-5 "
Cyanide of Potassium,	4½ "
Water,	1 gallon.
Aqua Ammonia,	1 4-5 fl. oz.

In the preparation of these baths the salts are all dissolved together, except the copper acetate and ammonia which are added after dissolving together in a small quantity of the water.

The deep blue color of the ammonia-copper solution should entirely disappear on mixing it with the other solution; otherwise, it becomes necessary to add more cyanide.

Cleansing Copper and Copper Alloys.

Potash, Caustic.	1 pound.
Water, Soft,	1 gallon.

Heat nearly to boiling in a cast iron pot provided with a cover. If the articles are much oxidized, pickle in a bath composed of—

Water,	1 gallon.
Sulphuric Acid,	1 pint.

until the darker portion is removed. Rinse in running water and dip in the following solution:

Water, soft, 1 gallon.
Cyanide of Potassium, 8 ounces.

Remove from the bath, and quickly go over every part with a brush and fine pumice stone powder moistened with the cyanide solution.

CLEANSING CAST-IRON.

Cast-iron is freed from grease, etc., by dipping in hot alkali solution used for a similar purpose with copper, and after rinsing thoroughly it is pickled in water containing one per cent of sulphuric acid for several hours; then rinsed in water and scoured with a fine sharp sand or pumice powder and a fiber brush.

It is then rinsed and returned to the acid pickle for a short time, rinsed again, and put into the plating bath directly.

CLEANSING WROUGHT-IRON.

The cleansing of wrought-iron, if much oxidized, is effected in the same manner as cast-iron; but it will bear a stronger pickle and a longer exposure. Whitened, filed, or polished iron may be treated like steel.

CLEANSING STEEL.

Dip in the caustic lye used for copper, etc., rinse thoroughly, scour with pumice powder moistened, rinse, and pass through the following dip:

Water, 1 gallon.
Hydrochloric Acid. 4 lbs.

Rinse quickly (but thoroughly) and plunge in the bath.

Clean wrought-iron and steel gild well without an intermediary coating in hot electro-gilding baths. It is difficult to obtain an adhering coating of silver on these metals without interposing an intermediate coating of copper or brass, which renders the further operation of silver plating easy.

Cleansing Zinc, Tin and Lead.

Zinc is cleansed by dipping a few moments only (as the alkali quickly attacks the metal) in the hot potash lye, rinsing, and dipping into water containing about 10 per cent of sulphuric acid for a few minutes. Rinse in plenty of hot water, and, if necessary, scour with pumice stone powder and a stiff brush, moistened with a weak cyanide solution, or scratch brush. This last operation is especially useful when parts have been united with tin solder.

Tin, lead, and the alloys of these metals are more difficult to cleanse perfectly than zinc or iron.

Scour rapidly with the hot potash and brush, rinse quickly and brush, or dress with a piece of soft clean wood.

It is very difficult to obtain a satisfactory deposit of gold

or silver directly upon these metals or their alloys. The results are much better if a coating of pure copper is interposed.

GOLD PLATING BY SOLUTION.

A solution of gold is made in nitro-muriatic acid, and there is added to it twice as much sulphuric ether. The mixture must be shaken and allowed to repose when the ether with the chloride of gold will separate from the remaining liquid and rest above it. This dark colored ethereal solution is poured off from the light colored liquid beneath, and can be preserved for use in tight bottles, excluded from light. When applied it is with a very fine brush, or camels hair pencil the ether evaporates immediately leaving a coating of gold. This is burnished after being heated. The adhesion is more perfect, however, if the article be raised to a temperature approaching redness.

GILDING BRASS AND COPPER.

Brass and copper may be readily gilt, by being dipped in a dilute *neutral* solution of chloride of gold, and then washed and burnished.

GILDING BRASS AND COPPER.

A process was patented in 1836 by an English toy maker, and is well adapted for small articles. It consists in immersion them in hot solution of chloride of gold, to which has been added a considerable excess of bicarbonate of soda.

COPPER DEPOSITS BY DIPPING.

This is seldom practiced except on iron, as the deposits thus obtained are generally wanting in lasting qualities, since, from the thinness of the coating, the iron is but imperfectly protected from atmospheric influences. If the iron is dipped in a solution of—

Sulphate of Copper,	3½ oz.
Sulphuric Acid,	3½ "
Water,	1 to 2 gal,

it becomes covered with a coating of pure copper, having a certain adhesion; but should it remain there a few minutes, the deposit becomes thick and muddy, and not stand any rubbing. Small articles such as pins, hooks, and nails, are thus coppered by tumbling them for a few moments in sand, bran, or sawdust impregnated with the above solution diluted with 3 or 4 volumes of water.

TIN DEPOSIT BY DIPPING.

When immersed in a hot solution of tin properly prepared the metal is precipitated upon their surfaces. One of the best solutions for this purpose is the following:

Ammonia Alum,	17¼ oz.
Boiling Water,	12½ "
Protochloride of Tin,	1 "

The articles to be tinned, first thoroughly cleaned, are put into the hot solution until properly whitened. A better coating can be obtained by using the following bath, and placing the pieces in contact with a strip of clean zinc also immersed:

Bitartrate of Potassa,	14 oz.
Water (soft)	24 "
Protochloride of Tin.	1 "

It should be boiled for a few minutes before using.

BRONZE DIP.

Nitric Acid,	8 oz.	Alum,	1 oz.
Muriatic Acid,	1 qt.	Salt,	2 "
Sal-Ammoniac	2 oz.	Water,	2 gal.

Add the salt after boiling the other ingredients, and use hot.

BROWN BRONZE DIP.

Iron scales, 1lb; Arsenic, 1 oz; Muriatic Acid, 1 lb: A piece of solid Zinc, 1 oz. in weight to be kept in while useing.

NICKEL-PLATING DIP.

Into the plating vessel which may be of porcelain, or copper, is placed a concentrated solution of zinc chloride, which is diluted with from 1 to 2 volumes of water and heated to boiling. (If any precipitate separates, it is to be redissolved by adding a few drops of hydrochloric acid). As much powdered zinc as can be taken on the point of a knife is thrown in, by which the vessel becomes covered internally with a coating of zinc. The nickel salt for which purpose either the chloride or sulphate may be used—is then added until the liquid is distinctly green; and the articles to be plated, previously thoroughly cleaned, are introduced, together with some zinc fragments. The boiling continues for fifteen minutes, when the coating of nickel is completed, and the process is finished. The articles are well washed with water and cleaned with chalk. If a thicker coating be desired, the operation may be repeated.

SILVERING POWDER.

Silver powder may be prepared in the following manner: Precipitate] silver from its solution in nitric acid, by dropping into it some plates of clean copper. Take 20 grs. of this powder and mix with it 2 drachms of cream of tartar the same quantity of common salt, and half a drachm of alum. These articles must be finely pulverized, and inti-

mately mixed in a mortar. If a little of this powder be moistened, and rubbed on a clean surface of brass or copper, the silver will be precipitated, and the surface of the metal will be covered with it.

STONE-WORK.

Stone walls are measured by the perch. A perch of stone is 24.75 cubic feet. When built in the wall, 2¾ cubic feet are allowed for the mortar and filling; hence, 22 cubic feet of stone make one perch of wall.

Masons estimate 3 pecks of lime and 4 bushels of sand to a perch of wall.

To find the number of perches of stone in a wall, multiply together the length, height and thickness, in feet, and divide by 22.

Openings less than 3 feet wide are counted solid; over 3 feet deducted, but 18 inches are added to the running measure for each jamb. Built arches are counted solid from their spring. Corners of buildings are measured twice. Pillars less than 3 feet are counted on 3 sides, as lineal, multiplied by fourth side and depth.

A cord of stone, 3 bushels of lime and a cubic yard of sand will lay 100 cubic feet of wall.

It is customary to measure all foundations and dimension of stone by the cubic foot. Water tables and base courses by lineal feet. All sills and lintels or ashlar, by superficial feet, and no wall less than 18 inches thick.

The Greatest Load per Superficial foot.

Granite Piers,	=	40 Tons.
Lime Stone Piers.	=	35 "
Sand " "	=	15 "
Brickwork in Cement.	=	3 "
Rubble Masonry.	=	2 "
Lime Concrete foundation.	=	2½ "

The height of brick or stone piers should not exceed 12 times their least thickness at base.

BRICK-WORK.

Brick work is generally measured by 1000 bricks laid in wall. In consequence of variation in size of bricks, no rule for volume of laid brick can be exact. The following scale is, however, a fair average.

7	common	bricks	to a	superficial	foot	4	inch	wall.
15	"	"	"	"	"	8	"	"
23	"	"	"	"	"	12	"	"
30	"	"	"	"	"	16	"	"
38	"	"	"	"	"	20	"	"
45	"	"	"	"	"	24	"	"

Corners are not measured twice as in stone work. Openings over two feet square are deducted. Arches are counted from the spring. Fancy work counted 1½ bricks for 1. Pillars are measured on their face only.

A cubic yard of mortar requires one cubic yard of sand and 9 bushels of lime, and will fill 30 hods.

One thousand bricks, closely stacked, occupy about 56 cubic feet.

One thousand old bricks, cleaned and loosely stacked, occupy about 72 cubic feet.

Five courses of brick will lay one foot in height on a chimney.

Nine bricks in a course will make a flue eight inches wide and twenty inches long, and eight bricks in a course will make a flue eight inches wide and 16 inches long.

One superficial foot of gauged arches requires 10 bricks.

Common bricks are 7¾ to 8 inches long by 4¼ wide and 2½ thick. Front bricks are ¼ inch longer and wider.

It requires 20 common bricks to lay one cubic foot. In an 8 inch wall 15 common bricks make one foot of wall.

Stock bricks commonly measure 8¾ inches by 4¼ inches, by 2¾ inches, and weigh from 5 to 6 pounds each.

Paving-bricks should measure 9 inches, by 4½ by 1¾ inches, and weigh about 4½ pounds each.

One yard of paving requires 36 stock bricks, of above dimensions, laid flat, or 52 on edge; and 35 paving laid flat, or 82 on edge.

To find the number of bricks in a wall 12 inches or more in thickness, multiply together the length, height and thickness, in feet, and that again by 20. For an 8 inch wall, multiply the length by the height, and that by 15, and the product will be the number of bricks in the wall. If the wall is perforated by openings, such as door, windows, etc., multiply the length of such openings by the width, and that by the thickness, and deduct from the cubic contents of the wall before multiplying by 15 or 20 as above.

Bricks should be well wetted before use. Sea sand should not be used in the composition of mortar.

RED WASH FOR BRICKS.

To remove the green that gathers on bricks, pour over them boiling water in which any vegetables, (not greasy), have been boiled. Repeat for a few days, and green will disappear. For the red wash melt one ounce of glue in one gallon of water; while hot add alum size of an egg, one-half pound Venetian red, one pound Spanish brown. Try it; if too light add more red and brown. If too dark, water.

NUMBER of BRICK required to CONSTRUCT any BUILDING.
(*Reckoning 7 bricks per superficial foot*).

Super. ft. of Wall.	Number of Bricks to Thickness of Wall.					
	4 inch.	8 inch.	12 inch.	16 inch.	20 inch.	24 inch
1	7	15	23	30	38	45
2	15	30	45	60	75	90
3	23	45	68	90	113	135
4	30	60	90	120	150	180
5	38	75	113	150	188	225
6	45	90	135	180	225	270
7	53	105	158	210	263	315
8	60	120	180	240	300	360
9	68	135	203	270	338	405
10	75	150	225	300	375	450
20	150	300	450	600	750	900
30	225	450	675	900	1125	1350
40	300	600	900	1200	1500	1800
50	375	750	1125	1500	1875	2250
60	450	900	1350	1800	2250	2700
70	525	1050	1575	2100	2625	3150
80	600	1200	1800	2400	3000	3600
90	675	1350	2025	2700	3375	4050
100	750	1500	2250	3000	3750	4500
200	1500	3000	4500	6000	7500	9000
300	2250	4500	6750	9000	11250	13500
400	3000	6000	9000	12000	15000	18000
500	3750	7500	11250	15000	18750	22500
600	4500	9000	13500	18000	22500	27000
700	5250	10500	15750	21000	26250	31500
800	6000	12000	18000	24000	30000	36000
900	6750	13500	20250	27000	33750	40500
1000	7500	15000	22500	30000	37500	45000

PLASTERING.

Estimate of Material for 100 square yards.

MATERIALS.	Two coats, slipped coat finished.	Three coats with hard finish.
Quick Lime,	3½ casks,	4 casks.
" for fine stuff,		⅔ "
Plaster of Paris,		½ "
Laths,	2000	2000
Hair,	3 bushels,	4 bushels.
Common Sand,	6 loads,	7 loads.
White Sand,		2½ bushels.
Nails,	13 pounds,	13 pounds.
Masons Labor,	3½ days,	4 days.
Laborer,	2 days,	3 days.
Cartage,	¾ days	1 day.

Plastering laths are usually of white or yellow pine, 1½ inches wide, ¼ inch thick, and 3 or 4 feet long. They are nailed up horizontally, about ½ inch apart. the upright stud or partitions are spaced at such distance apart (usually about 15 inches, centre to centre), that the ends of the laths may be nailed to them.

Laths are sold in bundles of 50 to 100 each. A square foot of surface requires, 1½ four-feet laths, or 1000 such laths will cover 74 square yards, and 12 pounds of nails will lay them on.

A carpenter can nail up the laths for from 40 to 60 square yards of plastering in a day of 10 hours, depending on the number of angles in the room, etc.

Plastering is always measured by the square yard for plain work, by the superficial foot for cornices or plain members, and by lineal foot for enriched members or carved mouldings in cornices.

The mortars used for inside plastering are termed course, fine, gauge or hard finish, and stucco.

Course stuff—Lime 1 part, sand 2 parts, hair 1-6 part.

Fine stuff (lime putty). Lump lime sclacked to a paste with a moderate volume of water. and afterwards diluted to the consistency of cream, and then to harden by evaporation to the required consistency for working.

Gauge stuff or Hard finish, is composed of from 3 to 4 volumes of fine stuff and one volume plaster of Paris, in proportions regulated by the degree of rapidity required in hardening; for cornices etc., etc., the proportions are equal volumes of each, fine stuff and plaster.

Stucco is composed of from 3 to 4 volumes of white sand, and one volume of fine stuff, or lime putty,

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SHINGLES.

The best shingles are of white cedar.

When of good quality, they will last about 45 years in our northern State. Cypress and white pine are much used for shingles, but will not last half as long as white cedar.

Shingles are packed 250 in the bundle, or 4 bundles to 1000. One bundle 16-inch shingles will cover 30 square feet.

One bundle 18-inch shingles will cover 33 square feet. When laid 5½ inches to the weather, 5 lbs,, (4p) or 3¾ lbs. (3p) nails will lay them on.

COST of TIN ROOFING.

The following table shows the cost per square and sq. foot of tin roofing laid with 14 by 20 tin and 20 by 28 tin both flat and standing seam.

(*A square is 100 square feet*).

Flat Seam Roofing.			Standing Seam Roofing.		
Cost with 14×20 Tin.			Cost with 14×20		
T. per box	Per sq.	Per sq.ft.	T. per box.	Per sq.	Per sq.ft.
$4.25	$2.21	.0221	$4.25	$2.37	.0237
4.50	2.34	.0234	4.50	2.51	.0251
4.75	2.47	.0247	4.75	2.65	.0265
5.00	2.60	.0260	5.00	2.79	.0279
5.25	2.73	.0273	5.25	2.93	.0293
5.50	2.86	.0286	5.50	3.06	.0306
5.75	2.99	.0299	5.75	3.20	.0320
6.00	3.12	.0312	6.00	3.34	.0334
6.25	3.25	.0325	6.25	3.48	.0348
6.50	3.38	.0338	6.50	3.62	.0362
6.75	3.51	.0351	6.75	3.76	.0376
7.00	3.64	.0364	7.00	3.90	.0390
Cost with 20×28 Tin.			Cost with 20×28 Tin.		
$8.00	$2.01	.0201	$8.00	$2.15	.0215
8.50	2.13	.0213	8.50	2.28	.0228
9.00	2.26	.0226	9.00	2.41	.0241
9.50	2.38	.0238	9.50	2.55	.0255
10.00	2.51	.0251	10.00	2.68	.0268
10.50	2.63	.0263	10.50	2.82	.0282
11.00	2.76	.0276	11.00	2.95	.0295
11.50	2.88	.0288	11.50	3.09	.0309
12.00	3.00	.0300	12.00	3.21	.0321
12.50	3.13	.0313	12.50	3.35	.0335
13.00	3.25	.0325	13.00	3.48	.0348
13.50	3.38	.0338	13.50	3.62	.0362

For solders see page 210

SLATING.

A square of slate or slating is 100 superficial feet.

In measuring, the width of the eaves is allowed at the widest part. Hips, valleys, and cutting are to be measured lineal, and 6 inches width extra is allowed.

The thickness of slates, ranges from 3-16 to 5-16 of an inch, and their weight varies from 2.6 to 4.5 lbs per square foot.

The lap of slates varies from 2 to 4 inches. The standard is assumed to be 3 inches.

The pitch of a slate roof should not be less than 1 inch in height to 4 inches in length.

DIMENSIONS OF SLATES AND NUMBER REQUIRED TO A SQUARE. (AMERICAN).

SIZE.	No. of Slate.	Weight per Sq. about.	SIZE.	No. of Slate.	Weight per Sq. about.
12 by 6	533	lbs.	18 by 11	174	lbs.
12 " 7	457	850	20 " 10	169	
12 " 8	400		20 " 11	154	650
14 " 7	374		20 " 12	141	
14 " 8	327	750	22 " 11	138	
14 " 9	291		22 " 12	126	
16 " 8	277		22 " 13	116	
16 " 9	246		24 " 12	114	675
16 " 10	221	650	24 " 13	105	
18 " 9	213		24 " 14	98	
18 " 10	192				

To compute the number of slates of a given size required per square. Subtract the lap from the length of the slate, and half the remainder will give the length of the surface exposed, which, when multiplied by the width of the slate, will give the surface required, and for which the party requiring the slating only pays.

Divide 14400 (the area of a square in inches) by the surface thus obtained, and the quotient will give the number of slates required for a square.

Illustration:—A slate is 24×12 inches, and the lap is 3 inches.

24−3=21, and 21÷2=10.5, which×12=126 inches; 14400÷126=144.29 slates.

Good American slate weighs about 174 pounds per cubic foot. Hence—

Slabs ¾ inch thick weigh 10.86 pounds per square foot.
" 1 " " " 14.5 " " " "
" 1¼ " " " 18.12 " " " "
" 1½ " " " 21.72 " " " "
" 2 " " " 29. " " " "

CORRUGATED IRON ROOFING.

Birmingham Wire Gauge.	W'g't per Square (100 Sq. feet). Plain or Painted.	GALVANIZED IRON.*
No. 28	97 lbs.	
26	105 "	Galvanized iron weighs from 5 to 15 per cent. heavier than plain, according to the No. Birmigham Wire Gauge.
24	128 "	
22	150 "	
20	185 "	
18	270 "	
16	340 "	

*See page 38 for sizes.

Lighter than No. 22 is not recommended, for a good durable roof.

Corrugated iron is usually made in sheets from 2 to 3 feet wide, and from 6 to 8 long.

The sheets when used for roofing should overlap about 6 inches in girth, and be double-riveted at the joints.

One-third of the net width may be allowed approximately for lappage and corrugations.

From 2½ to 3½ pounds of rivets will be required for a square.

PAINTING.*

For outside wood-work, paint made from white lead ground in linseed oil is most used. If the oil is raw, or unboiled, dryer is added ; if boiled no dryer is necessary. Not less than four coats should be applied,—five are better.

Paint, ready mixed, put up in cans or kegs, may be procured from manufacturers or dealers. These paints have to be thinned by adding 1 pint of oil to about 2½ pounds of paint. When thinned, 1 pound will cover about 2 square yards; of first coat, 3 yards of second, and 4 yards of each subsequent coat; or 1⅜ pounds, to the square yard will be required for 4 coats, and 1⅝ for 5 coats.

For inside work, either white lead or oxide of zinc is used, and for good work 4 coats are necessary.

For iron exposed to the weather, metallic paint, such as yellow and red iron ochres or brown hematite ore, finely pulverized and mixed with oil or dryer, are best. If to the action of the water red lead is best.

Plastered walls should stand a year before painting.

Painting is measured by the square yard, girding every part of the work that is covered by paint and allowing an addition to the actual surface for the difficulty of covering deep quirk of mouldings and for "cutting in" as in sash and shelving, or where there is a change of color, on some work. Painters putty is made of spanish whiting, pulverized, 80 parts; boiled oil 20 parts; make into a stiff paste. If not intended for immediate use, raw oil shuld be used. One pound of putty for stopping every 20 yards.

GLAZIERS PUTTY.

Whiting, 70 pounds; boiled oil, 30 pounds; water 2 gals. mix. If too thin add more whiting; if too thick add more oil.

TO SOFTEN PUTTY.

To remove old putty from broken windows, dip a small brush in nitro-muriatic acid or caustic soda (concentrated lye), and with it anoint or paint over the dry putty that adheres to the broken glass and frames of your windows; after an hours interval the putty will have become so soft as to be easly removable.

* For mixing colors see page 109.

WASHES.

FOR OUTSIDE WORK.—In a tight box, slack half a bushel of fresh lime by pouring over it boiling water sufficient to cover it 4 or 5 inches deep, stir until slacked; add 2 lbs. of sulphate of zinc dissolved in water, add water enough to bring all to the consistency of thick white-wash

FOR INSIDE WORK.—Add 2 quarts of thin size to a pail-ful of wash just before using. The common practice of mixing salt with white-wash should not be permitted.

WHITE-WASH.—Whiting 4 pounds; common glue, two ounces; stand glue in cold water over night; mix whiting with cold water, heat glue till dissolved, and pour it hot into the former. Make of consistency to apply with common white-wash brush.

WHITE-WASH that will not rub off.—Mix up half pail full of lime and water, ready to put on the wall; then take one-fourth pint of flour, mix it with water, then pour on it a sufficient quantity of boiling water to thicken it, and pour it while hot into the white-wash; stir all well together, and it is ready for use.

FOR BRICK OR STONE WORK.—Slack ½ bushel of lime, as before in a barrel; then fill the barrel ⅔ full of water and add a bushel of hydraulic cement; add 3 pounds sulphate of zinc dissolved in water. The washes may be colored by adding powdered ochre, umber, etc.

DYEING.

GENERAL REMARKS.

Everything should be clean. The goods should be scoured in soap and the soap rinsed out. They are often steeped in soap lye over night. Dip them into water just before putting them into preparations, to prevent spotting. Soft water should be used, *sufficient to cover the goods* well—*this is always understood where quantity is not mentioned.* When goods are dyed, air, rinse well, and hang up to dry. Do not wring silk or merino dresses when scouring or dyeing them. If cotton goods are to be dyed a light color, they should be bleached.

SILKS.

BLACK.—Make a weak dye as for black on woolens; work goods in bichromate of potash a little below boiling heat, then dip in the logwood in same way; if colored in blue vitriol dye, use about the same heat.

ORANGE.—For one pound goods—annotto, one pound; soda, one pound; repeat as desired.

GREEN.—Very Handsome—For one pound goods—yellow oak bark, eight ounces; boil one half hour; turn off liquor from bark and add alum, six ounces; let stand until cold;

while making this, color goods in blue dye-tub a light blue; dry and wash; dip in the alum and bark dye. If it does not take well, warm the dye a little.

PURPLE.—For one pound goods.—First obtain a light blue, by dipping in home-made dye-tub; then dry; dip in alum, four ounces, with water to cover, when little warm. If color is not full enough add chemic.

YELLOW.—For one pound goods—alum, three ounces; sugar of lead, three-fourths ounce; immerse goods in solution over night; take out; drain, and make a new dye with fustic. one pound; dip until required color is obtained.

CRIMSON.—For one pound goods—alum, three ounces; dip at hand heat one hour; take out and drain while making new dye by boiling ten minutes, cochineal, three ounces, bruised nut-galls, two ounces, and cream-tartar, one-fourth ounce, in one pail of water; when little cool, begin to dip, raising heat to boil; dip one hour; wash and dry.

SKY BLUE ON SILK OR COTTON.—Very beautiful.—Give goods as much color from a solution of blue vitriol, two ounces, to water, one gallon. as it will take up in dipping fifteen minutes, and then run it through lime water. This will make a beautiful and durable sky blue.

BROWN ON SILK OR COTTON.—Very beautiful—After obtaining a blue color as above, run goods through a solution of prussiate of potash, one ounce, to water, one gallon

LIGHT BLUE.—For cold water, one gallon, dissolve alum, one-half tablespoon, in hot water, one tea-cup, and add to it, then add chemic, one teaspoon at a time to obtain the desired color—the more chemic, darker the color.

WOOLEN GOODS.

CHROME BLACK.—Best in use.—For five pound goods, blue vitriol, six ounces; boil a few minutes, then dip goods three-fourths hour, airing often; take out goods. make a dye with three pounds logwood, boil one-half hour; dip three-fourths hour and air goods, and dip three-fourths hour more. Wash in strong suds. This will not fade by exposure to sun.

WINE COLOR.—For five pound goods, camwood, two pounds; boil fifteen minutes and dip goods one-half hour; boil again and dip one-half hour; then darken with blue vitriol, one and one-half ounces; if not dark enough, add copperas, one-half ounce.

SCARLET.—Very fine.—For one pound goods—cream-tartar, one-half ounce; cochineal, well pulverized, one-half ounce; muriate of tin, two and one-half ounces; boil up the dye and enter the goods; work them briskly for ten or fifteen minutes, then boil one and one-half hours, stirring

goods slowly while boiling. Wash in clean water and dry in the shade.

PINK.—For three pound goods—alum, three ounces; boil and dip the goods one hour; then add to the dye, cream-tartar, four ounces; cochineal, well pulverized, one ounce; boil well and dip the goods while boiling until the color suits.

BLUE.—Quick Process.—For two pound goods—alum, five ounces; cream-tartar, three ounces; boil goods in this one hour, then put goods in to warm water which has more or less extract of indigo in it, according to the depth of color desired, and boil again until it suits, adding more of the blue if needed.

MADDER RED.—To each pound of goods—alum, five ounces; cream-tartar, one ounce. Put in goods and bring kettle to a boil, for one-half hour, then air them and boil one-half hour longer; empty kettle and fill with clean water; put in bran, one peck; make it milk-warm, and let it stand until bran rises, then skim off the bran and put in one-half pound madder; put in goods and heat slowly until it boils and is done. Wash in strong suds.

GREEN.—For each pound of goods-fustic, one pound; with alum, three and one-half ounces; steep until strength is out, and soak goods therein until a good yellow is obtained; then remove the chips and add extract of indigo or chemic, one tablespoon at a time, until color suits.

SNUFF BROWN, DARK.—For five pound goods—camwood, one pound; boil it fifteen minutes, then dip goods three-fourths hour; take out goods, and add to the dye, two and one-half pounds fustic; boil ten minutes and dip goods three-fourths hour; then add blue vitrol, one ounce; copperas, four ounces; dip again one half hour. If not dark enough, add more copperas.

ANOTHER METHOD.—Any shade.—Boil goods in a mordant of alum, two parts; copperas, three parts; then rinse them through a bath of madder. The tint depends on the relative proportions of the copperas and alum; the more copperas, the darker the dye. Joint weight of both should not be more than one-eighth of weight of goods. Mixtures of reds and yellows with blues and blacks, or simple dyes, will make any shade.

ORANGE.—For five pound goods—muriate of tin, six tablespoons; argal, four ounces; boil and dip one hour, and add again to the dye one tea-cup madder; dip again one-half hour. Cochineal, about two ounces, in place of madder, makes a much brighter color.

PURPLE.—For each pound goods—two ounces cudbear; rinse goods well in soap suds, then dissolve cudbear in hot suds—not quite boiling—and soak the goods until of requir-

ed color. The color is brightened by rinsing in alum water.

YELLOW.—Rich.—Work five pound goods one-half hour in a boiling bath with three ounces bichromate of potassa and two ounces alum; lift and expose till well cooled and drained, then work one-half hour in another bath with five pounds fustic. Wash out and dry.

CRIMSON.—Work for one hour in a bath with one pound cochineal paste; six ounces dry cochineal; one pound tartar, one pint protochloride of tin. Wash out and dry.

SALMON.—For each pound goods—¼th pound annotto; one-fourth pound soap; rinse goods in warm water, put them into mixture and boil one-half hour. Shade will be according to amount of annotto.

DOVE and SLATE COLORS—of all shades.—Boil in iron vessel a teacup of black tea with teaspoon of copperas, and sufficient water. Dilute till you get the shade wanted.

COTTON GOODS.

BLACK.—For five pound goods—boil them in a decoction of three pounds sumach one-half hour, and steep twelve hours; dip in lime water one-half hour; take out and let them drip one hour; run them through the lime water again fifteen minutes. Make a new dye with two and one-half pounds logwood (boiled one hour), and dip again three hours; add bichromate potash, two ounces to the logwood dye, and dip one hour. Wash in clear cold water and dry in shade. Only process for permanent black.

SKY BLUE.—For three pound goods—blue vitriol, four ounces; boil few minutes, then dip goods three hours; then pass them through strong lime water. *A beautiful* BROWN can be obtained by next putting goods through a solution of prussiate of potash.

GREEN.—Dip goods in home-made blue; dye until blue enough is obtained to make the green as dark as required; take out, dry and rinse a little. Make a dye with fustic, three pounds, logwood, three ounces. to each pound goods, by boiling dye one hour; when cooled so as to bear hand, put in goods, move briskly few minutes, and let lie one hour; take out and thoroughly drain; dissolve and add to the dye for each pound of cotton, blue vitriol, one-half ounce, and dip another hour. Wring out and let dry in the shade. By adding or diminishing the logwood and fustic, any shade may be had.

YELLOW.—For five pound of goods—seven ounces sugar of lead; dip goods two hours; make new dye with bichromate of potash, four ounces; dip until color suits; wring out and dry. If not yellow enough, repeat.

ORANGE.—For five pound goods—sugar of lead, four

ounces; boil few minutes; when a little cool, put in goods; dip two hours; wring out; make a new dye with bichromate of potash, eight ounces; madder, two ounces; dip until it suits; if color is too red, take small sample and dip into lime water and choose between them.

RED.—Muriate of tin, two-thirds teacup; add water to cover goods; raise to boiling heat; put in goods one hour; stir often; take out, empty kettle, put in clean water with nicwood, one pound; steep one-half hour at hand heat; then put in goods and increase heat one hour—not boiling. Air good and dip one hour as before. Wash without soap.

PRINTING.

EXPLANATION OF POINT SYSTEM.

1 Point.	12 to pica
2 "	6 to pica
3 "	4 to pica
3½ "	Brilliant
4 "	3 to pica
4½ "	Diamond
5 "	Pearl
5½ "	Agate
6 "	Nonpareil
7 "	Minion
8 "	Brevier
9 "	Bourgeois
10 "	Long Primer
11 "	Small Pica
12 "	2 line Nonpareil
14 "	2 line Minion or English
16 "	2 line Brevier or Columbian
18 "	3 line Nonpareil or Great Primer
20 "	2 line Long Primer or Paragon
24 "	4 line Nonpareil
30 "	5 " "
36 "	6 " "
42 "	7 " "
48 "	8 " "
60 "	10 " "
72 "	12 " "

SIZES OF PRINTING TYPES.

NAME OR BODY.	Size in dec. of a lin. inch.	Body larger than that preceding.	Ems & dec of an em in a lineal foot.	Ems & dec. of an 'm in a sq. ft.
Diamond.	.0595	lineal in.	201.587	40,637.46
Pearl.	.0668	.0072	179.593	32,253.97
Agate.	.075	.0081	160.	25,600.
Nonpareil.	.0841	.0091	142.543	20,318.73
Minion.	.0994	.0103	126.992	16,126.98
Brevier.	.1060	.0115	113.137	12,800.
Bourgeois.	.1190	.0129	100.793	10,159.36
Long Primer.	.1336	.0145	89.796	8,063.49
Small Pica.	.15	.0163	80.	6,400.
Pica.	.1683	.0183	71.271	5,031.74
English.	.1889	.0206	63.496	4,031.74
Columbian.	.2121	.0231	56.568	3,200.
Great Primer.	.2381	.0259	50.396	2,539.84
Paragon.	.2672	.0291	44.898	2,015.87
Double Small Pica.	.3	.0327	40.	1,600.
Double Pica.	.3367	.0367	35.635	1,269.92
Double English.	.3779	.0412	31.748	1,007.93
Double Columbian.	.4242	.0462	28.284	,800.

American and British Types are cast 92-100 ths of an inch in height. The European Printing Types are of many different heights.

SIZES AND WEIGHTS OF PAPER.

Owing to the variations in sizes and weight of paper made by different mills, it is almost impossible to give a perfect scale. The following, however, are the sizes and weights most generally used.

NEWS PAPER.

Imperial	22×32	22, 25 lbs.
Small Double Medium	24" 36	25, 28. 30 lbs.
Double Medium	24" 38.	28, 30, 32, 36. 40, 44, 50.
Double Royal	25" 39 and 26×40.	36, 40. 50, 60.
Double Super Royal	28" 42 and 29×43	36. 40 lbs.
Double Imperial	32" 46 and 33×46	45, 50, 53."

BOOK PAPER.

†Medium	19×24	25, 30, 35 lbs.
* "	20" 24	.20, 25, 30, 40 lbs.
†Super Royal	22" 28	30, 40 lbs.
* "	22" 28	.35, 40, 50, 60, 70, 80 lbs.
Medium-and-half	24" 30	.30, 40 lbs.; unsized.
†Double Medium	24" 38.	32, 36, 40, 44, 50, 56, 60.
* " "	24" 38	.35, 40, 45, 50, 60, 70. 80.
*Double Royal	26" 40	40, 50, 60 lbs.

*Double Super Royal,	28×42	45, 50, 60 lbs.
Double Imperial,	32" 46	65, 70 lbs.; unsized.
*Sized and calendered.	†Sized and unsized.	

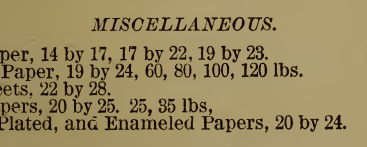
FLAT PAPER.

Flat Letter,	10×16	7, 8, 9, 10, 12, 14 lbs.
" Small Cap,	13" 16	12, 14,16 lbs,
" Cap,	14" 17	10, 12, 14, 16, 18 lbs.
" Crown,	15" 20	21 lbs.
" Demy,	16" 21	16, 18, 20 22, 24, 28 lbs.
" Folio,	17" 22	14, 16, 18, 20, 22, 24 lbs.
" Double Cap.	17" 28	24, 28, 32, 36 lbs.
" Medium,	18" 23	24. 28, 32, 36, 40 lbs.
" Royal,	19" 24	42 lbs.
" Super Royal,	20" 28	52 lbs.
" Imperial	22" 30	65 lbs.

MISCELLANEOUS.

Bond Paper, 14 by 17, 17 by 22, 19 by 23.
Blotting Paper, 19 by 24, 60, 80, 100, 120 lbs.
Card Sheets, 22 by 28.
Cover Papers, 20 by 25. 25, 35 lbs,
Glazed, Plated, and Enameled Papers, 20 by 24.

UPPER CASE.



LOWER CASE.

Average Daily Performance of Presses.

The estimates of the following table are for miscellaneous work, done in the usual manner, with little making ready, and under the favorable conditions of a brisk season. It is supposed that the presses are at work full ten hours; that feeders and pressmen are expert and diligent; that paper, rollers, steam power, ink, etc., are in perfect order, and that there are no detentions or accidents:

Make Ready Time.	Style of Press.—No. of Forms.	Time of Press Work.	Rate per hour.	Daily perf'r-ance.
Hours.		Hours.		Impr.
	Card Press.			
1	1 form of 7.500 impressions.	9	833	7.500
4	4 " 1.000 "	6	666	4.000
6	8 " 250 "	4	500	2.000
	Small Machine Press.			
1	1 form of 6.000 impressions.	9	666	6.000
5	5 " 500 "	5	500	2.500
8	8 " 100 "	2	400	800
	Hand Press.			
1	1 form of 1.500 impressions.	9	156	1.500
4	4 " 250 "	6	166	1.000
	Medium Cylinder.			
1	1 form of 7.500 impressions.	9	833	7.500
5	5 " 750 "	5	750	3.750
7	8 " 250 "	3	666	2.000
	Double Medium Cylinder.			
2	1 form of 5,000 impressions.	8	666	5.000
5	3 " 1.000 "	5	600	3.000
7	6 " 250 "	3	500	1.500
	Mammoth Cylinder.			
3	1 form of 4.000 impressions.	7	570	4.000
5	2 " 1.250 "	5	500	2.500
7	4 " 250 "	3	333	1.000

MEASURING TYPE OR MATTER.

The measurement is made by multiplying the number of solid ems contained in the length of any body of type, by the number contained in the width of the measure. The gauge for measurement is an em of the type in which the matter calculated is set.

In book offices it is usual to count the matter appearing below the head line in the above manner, counting three ems in addition for the head line with its blank and the foot line, without regard to the size of the type in which

they are set. In measuring the subject matter, anything in excess of an em and less than a half em is not counted, while an en, or an excess making less than an em, is counted as a full em.

Chapter heads, blank spaces, or cuts occurring in the dimensions of pages are rated the same as though the space occupied consisted of type. It is also customary to count as type a cut occupying a whole page when backed by printed matter.

Quotations, poetry, and matter set in smaller type than the body of the work, are always counted according to the size of type in which they are set, distinct from the larger type in the same page or body of matter, commencing at the first line and extending to the first line of the larger type.

Pages set in columns, include all spaces between the columns and bordered pages are measured from outside to outside of border by the ems of the type which they enclose.

Side and centre notes, in Bibles or law works, are measured by the full width of the note and the full length of the page, in the type of which they are composed.

The mode of acertaining the number of ems in a line is by laying as many of the letter m flatwise in the stick as will make the measure.

It is customary in many newspaper offices to count the rule set between the advertisements as a line of type, although it may not be of the required depth. This necessitates counting the lines where a number are set together.

COMBINATION LEADS.

The following table shows the combinations that can be formed by leads or slugs of six lengths only, not more than three pieces being required at one time.

LENGTH IN EMS OF THE PIECES EMPLOYED.

4, 7, 9, 13, 15, 20.

4,	4	8	13,	13	26	15,	15, 9	39
7,	4	11	20,	7	27	20,	20	40
4,	4, 4	12	15,	13	28	15,	13, 13	41
7,	7	14	20,	9	29	20,	15, 7	42
9,	7	16	15,	15	30	15,	15, 13	43
13,	4	17	20,	7, 4	31	20,	20, 4	44
9,	9	18	15,	13, 4	32	15,	15, 15	45
15,	4	19	20,	13	33	20,	13, 13	46
7,	7, 7	21	15,	15, 4	34	20,	20, 7	47
15,	7	22	20,	15	35	20,	15, 13	48
15,	4, 4	23	20,	9, 7	36	20,	20, 9	49
20,	4	24	15,	15, 7	37	20,	15, 15	50
9,	9, 7	25	20,	9, 9	38			

The printer has also at command the six single pieces used, viz: 4, 7, 9, 13, 15 and 20 ems. By using four, five, or six pieces together, the above combinations may be extended, consecutively to one hundred ems. Fonts of these leads, of suitable proportions, are put up and for sale by the different type founders.

CASTING OFF COPY.

The first step necessary is to take a comprehensive view of the copy, noticing whether it has been written even or has many interlineations, etc., and observing also the number of break-lines, and whether the work be divided into chapters and sub-heads, in order that the allowance may be made for them in the calculation. These observations may be noted on a separate piece of paper, to assist the memory and save the trouble of re-examining the manuscript. This preparation being made, we ascertain the number of words contained in the line by counting several separate lines in various parts of the copy, so that the one we adopt may be a fair average. We then take the number of lines in a page, and multiply by the number of words found in the average line. The quotient we then multiply by the quantity of folios the manuscript copy may contain, and thus we get the amount of words contained in the work, with a tolerable degree of accuracy. The necessary allowances should be made for breaklines chapters, insertions, etc., according to the observations previously made on the memorandum. If information has been furnished as to the size of letter the work is to be done in and the width of the page, we make our measure accordingly, and, by composing a few lines of the manuscript copy, we ascertain what number of words will come into each printed line. We then take the length of our page in lines, and multiply the one by the other, thus getting the number of words in the printed page. The quotient gives the number of pages the manuscript will make. If too many, the page must be enlarged; if too few, the page must be diminished in width and length. For example: We take the number of words in a line of manuscript at 20, the lines in a page at 50; we multiply 50 by 20, which will produce 1,000 words in a page; we then multiply 1,000 by 422, the number of the folios in the manuscript, and we find it contains 422,000 words. The work being printed in Pica octavo, 20 ems measure, and each line containing 10 words, each page 40 lines, the case will stand thus.

Manuscript.	*Printed.*
50 20 — 1000 422 — 2000 2000 4000 — 422000 words in MS.	40 10 — 400)422000 words in MS. 1055 pages. Divide 16)1055(65 sheets. 15 pages.

HOW TO BEND BRASS RULE.

By taking brass rule and heating it until about to turn red. and then immersing it in cold water, it can be easily bent to any desired shape.

RILEY'S INDISPENSABLE.

No. 1—For Fine Job Work. Dumar Varnish, 6 oz; Bergamot, 2 drachms; Balsam Copaiba, 2 drachms; Balsam of Fir, 3 oz., Creosote, 1 drachm; Copal Varnish one drachm. To enough ink for 1.000 ordinary business cards, add from 8 to 12 drops of the "Indispensable," and to larger quantities in proportion. When used for Bronze, Dry Colors, Diamond Printing, etc., take twice the quantity; and where an extra quick dryer is desired, add a few drops of dissolved Gum Arabic to the ink, after it has mixed with No. 1. In all cases, mix well with the ink before applying to the rollers.

HOW TO ESTIMATE THE QUANTITY OF TYPE.

To ascertain the quantity of Plain Type required for a Newspaper or Magazine, or any other work, find the number of square inches and divide the same by four, the quotient will be the approximate weight of matter: But as it is impossible to set the cases entirely clear it is necessary to add 25 per cent. to large fonts, and 33 per cent. to small fonts for dead matter.

Rule and figure work double price matter.

ROMAN NUMERALS.

Capitals are chiefly employed in designating the order of successton of kings, in chapter headings, and in indicating dates; while lower case are used as folios of a book, or to indicate chapter or verses referred to in the text.

The Following is a Complete System of Roman Enumeration.

1 I.	60 LX.
2 II.	70 LXX.
3 III.	80 LXXX, or XXC.
4 IIII or IV.	90 LXXXX, or XC.
5 V.	100 C.
6 VI.	200 CC.
7 VII.	300 CCC.
8 VIII. or IIX.	400 CCCC.
9 VIIII. or IX.	500 D, or Iↀ.
10 X.	600 DC, or IↀC.
11 XI.	700 DCC, or IↀCC.
12 XII.	800 DCCC, or IↀCCC.
13 XIII. or XIIV.	900 DCCCC, or IↀCCCC.
14 XIIII. or XIV.	1,000 M. or CIↀ.
15 XV.	2,000 CIↀCIↀIICIC.
16 XVI.	5,000 $\overline{\text{IV}}$ or Iↀↀ.
17 XVII.	10,000 $\overline{\text{X}}$ or CCIↀↀ.
18 XVIII. or XIIX.	50.000 $\overline{\text{L}}$ or Iↀↀↀ.
19 XVIIII or XIX.	100,000 $\overline{\text{C}}$ or CCCIↀↀↀ.
20 XX	1,000,000 $\overline{\text{M}}$ or CCCCIↀↀↀↀ.
30 XXX	2,000,000 $\overline{\text{MM}}$.
40 XXXX or XL.	
50 L.	

As often as a character is repeated, so many times is its value repeated.

A less character before a greater diminishes its value, as IV=V−I, or 1 subtracted from 5=4.

A less character after a greater increases its value, as XI=X+I, or 1 added to 10=11.

For every ↀ annexed, the sum is increased 10 times.

For every C and ↀ, placed one at each end, the sum becomes 10 times as many.

A bar thus ¯, over any number, increases it 1,000 times.

Illustration.—1840, MDCCCXL. 18560, $\overline{\text{XVIII}}$DLX.

FOLDING PAPER.

FOLIO.—The standard size of this is 25 by 38. The half sheet folded in two leaves, having four pages, makes a book called a folio.

QUARTO.—When the half sheet is folded in four leaves, making eight pages, it forms a quarto.

OCTAVO.—The half sheet folded again, eight leaves, sixteen pages, forms an octavo; or folded in sixteen leaves forms a 16 mo.

DUODECIMO.—By folding the same into twelve leaves, making twenty-four pages, we have a duodecimo. Folded into eighteen leaves, we form an 18 mo., into twenty-four leaves, and we have a 24 mo., etc.

The words, Post, Crown, Demy, Royal, etc., used in connection, as Royal Octavo, designate the size of paper of which the book is made.

Modern facilities for the manufacture of paper enable publishers to have any desired size made to order.

Marks occasionally found at the bottom of a page are termed signatures (such as a. b. c; or 1, 2, 3; or 1* 2* 3*), and are used for the direction of the pressman and binder in printing, folding and gathering sheets.

Amount of Paper Required for a Book of any Size.

No. of form.	Number of Pages in a Form.							Amount for 1000 cop's in R. & qr.
	8 Mo	12 Mo	16 Mo	18 Mo	24 Mo	32 Mo	36 Mo	
1	8	12	16	18	24	32	36	1 R 2qr
2	16	24	32	36	48	64	72	2—— 4
3	24	36	48	54	72	96	108	3—— 6
4	32	48	64	72	96	128	144	4—— 8
5	40	60	80	90	120	160	180	5——10
6	48	72	96	108	144	192	216	6——12
7	56	84	112	126	168	224	252	7——14
8	64	96	128	144	192	256	288	8——16
9	72	108	144	162	216	288	324	9——18
10	80	120	160	180	240	320	360	11——
11	88	132	176	198	264	352	396	12—— 2
12	96	144	192	216	288	384	432	13—— 4
13	104	156	208	234	312	416	468	14—— 6
14	112	168	224	252	336	448	504	15—— 8
15	120	180	240	270	360	480		16——10
16	128	192	256	288	384	512		17——12
17	136	204	272	306	408			18——14
18	144	216	288	324	432			19——16
19	152	228	304	342	456			20——18
20	160	240	320	360	480			22——
21	168	252	336	378	504			23—— 2
22	176	264	352	396				24—— 4
23	184	276	368	414				25—— 6
24	192	288	384	432				26—— 8
25	200	300	400	450				27——10

EXAMPLE:—How many reams will be required for a 16 mo. book of 320 pages? Find the number of pages (320) in the 16 mo column; and on the same line in the outer column we find 22 reams. For books with a greater number of forms than is given in the table find the quantity for half the forms and multiply by 2. If the forms are odd subtract 1 from its number and find ½ multiply by 2 then add the first figures in the outer column (1 R. & 2 qrs).

TABLE SHOWING THE QUANTITY of PAPER REQUIRED for ANY JOB of FROM 50 to 10,000 COPIES. FROM 2 to 48 to a SHEET. (*No allowance is made for waste or over copies*).

No. of Copies Req'ed	qrs	shts	qrs	shts	qrs	shts	qrs	shts	qrs	shts	qrs	shts	qrs	shts	qrs	shts	qrs	shts	qrs	shts	qrs	shts	qrs	shts	qrs	shts
	2		3		4		6		8		9		12		15		16		18		20		24		32		36		48	
50	1	1	0	17	0	13	0	9	0	7	0	6	0	5	0	4	0	4	0	3	0	3	0	3	0	2	0	2
100	2	2	1	10	1	1	0	17	0	13	0	12	0	9	0	7	0	7	0	6	0	5	0	5	0	4	0	3	0	3
200	4	4	2	19	2	2	1	10	1	1	0	23	0	17	0	14	0	13	0	12	0	10	0	9	0	7	0	6	0	5
250	5	5	3	12	2	15	1	18	1	8	1	4	0	21	0	17	0	16	0	14	0	13	0	11	0	8	0	7	0	6
300	6	6	4	4	3	3	2	2	1	14	1	10	1	1	0	20	0	19	0	17	0	15	0	13	0	10	0	9	0	7
400	8	8	5	14	4	4	2	19	2	2	1	21	1	10	1	3	1	1	0	23	0	20	0	17	0	13	0	12	0	9
500	10	10	6	23	5	5	3	12	2	15	2	8	1	18	1	10	1	8	1	4	1	1	0	21	0	16	0	14	0	11
600	12	12	8	8	6	6	4	4	3	3	2	19	2	2	1	16	1	14	1	10	1	6	1	1	0	19	0	17	0	13
700	14	14	9	18	7	7	4	21	3	16	3	6	2	11	1	23	1	20	1	15	1	11	1	6	0	22	0	20	0	15
750	15	15	10	10	7	20	5	5	3	22	3	12	2	15	2	3	1	23	1	18	1	14	1	8	1	0	0	21	0	16
800	16	16	11	3	8	8	5	14	4	4	3	17	2	19	2	6	2	2	1	21	1	16	1	10	1	1	0	23	0	17
900	18	18	12	12	9	9	6	6	4	17	4	4	3	3	2	12	2	9	2	2	1	21	1	14	1	5	1	1	0	19
1000	20	20	13	22	10	10	6	23	5	5	4	16	3	12	2	19	2	15	2	8	2	2	1	18	1	8	1	4	0	21
1250	26	1	17	9	13	1	8	17	6	13	5	19	4	9	3	12	3	7	2	22	2	15	2	5	1	16	1	11	1	3
1500	31	6	20	20	15	15	10	10	7	20	6	23	5	5	4	5	3	22	3	12	3	3	2	15	1	23	1	18	1	8
1750	36	11	24	8	18	6	12	4	9	3	8	3	6	2	4	22	4	14	4	2	3	16	3	1	2	8	2	1	1	13
2000	41	16	27	19	20	20	13	22	10	10	9	7	6	23	5	14	5	5	4	16	4	4	3	12	2	15	2	8	1	18
2500	52	2	34	18	26	1	17	10	13	1	11	15	8	17	7	0	6	13	5	20	5	5	4	9	3	7	2	22	2	5
3000	62	12	41	16	31	6	20	20	15	15	13	22	10	10	8	8	7	20	6	23	6	6	5	5	3	22	3	12	2	15
4000	83	8	55	14	41	16	27	19	20	20	18	13	13	22	11	3	10	10	9	7	8	8	6	23	5	5	4	16	3	12
5000	104	4	69	11	52	2	34	18	26	1	23	4	17	9	13	22	13	1	11	14	10	10	8	17	6	13	5	19	4	9
10000	208	8	138	22	104	4	69	11	52	2	46	8	34	18	27	19	26	1	23	4	20	20	17	9	13	1	11	14	8	17

COMPOSITION ROLLERS, for Summer Use.

Are made of a mixture of the best glue and refined syrup, in the proportion of 10 pounds glue to 5 quarts of syrup. Soften, but not over soak, the glue with water; then melt it; then add the syrup and let the mixture boil briskly for 30 minutes.

WINTER USE.

Composition Rollers for winter use, or for extreme cold weather, are made in the proportions of five pounds of glue to five quarts of syrup. This makes a tender roller, which may be stiffened by adding 2 ounces of tar.

Roller composition should not be over cooked: If it is boiled 40 or 50 minutes, or more, the syrup will candy, and the composition will be spoiled.

How to Mix Printing Ink (and Paints) For Tints.

Mixing Red and Black makes	Brown.
Lake and White makes	Rose.
Umber and White makes	Drab.
White and Brown makes	Chestnut.
Yellow and Brown makes	Chocolate.
Red with Light Blue makes	Purple.
Carmine with Straw makes	Flesh color.
Blue with Lead color makes	Pearl.
Carmine with White makes	Pink.
Lamp-Black with Indigo makes	Silver Gray.
" " " White makes	Lead color.
Paris Green with White makes	Bright Green.
Yellow-Ochre and White makes	Buff.
White tinted with Purple makes	French White.
Black with Chrome Green makes	Dark Green.
Emerald Green with White makes	Brilliant Green.
Vermillion with Chrome Yellow makes	Orange.
Chrome Yellow and White Lead makes	Straw col'r.
White tinted with Red and Yellow makes	Cream.
Chrome Yellow, Blue, Black and Red makes	Olive.
Chrome Green with White makes	Pea Green.
Yellow and Carmine or Deep Red makes	Scarlet.
Carmine and Blue makes	Deep Lilac, Violet Purple and Plum.
Blue and Black makes	Deep Blue or Blue-Black.
Vermillion and Black makes	Rich Brown.
Yellow and Black makes	Bronze Green.
Yellow Blue and Black makes	Deep Green.
Orange Mineral and White make	beautiful Flesh Tints.
Violet and White makes	pale Lilac or Lavender.

Mixing Yellow and Blue makes bright or a Light Green.
Ultramarine, White and Carmine form the various tones of Lilac, etc.

Red, yellow and black makes	Copper.
Red, umber and black makes	Claret.
White, vermillion, blue and yellow makes	Dove.
White, yellow and red makes	Fawn.
Red, black, yellow ochre and white,	Free stone.
White, Prussian blue and gray,	French Gray.
White, stone ocher and red makes	Gold.
White and chrome yellow makes.	Lemon.
White, yellow ochre, black and red,	Limestone.
White and vermillion, makes,	Peach.
White, vermillion and Lake makes,	Pink.
White, yellow ocher, black and red.	Sandstone.
Red, blue and white makes,	Violet,

Combination of Ink that Harmonize Well.

Two Colors.—Scarlet Red and Deep Green; Orange and Violet; Light Blue and Deep Red; Yellow and Blue; Black and Salmon; Black and Light Green; Dark and Light Blue; Carmine and Emerald; Brown and Carmine; Purple and Green. *Three Colors.*—Red, Yellow and Blue; Orange. Black and Light Blue; Light Salmon, Dark Green and Scarlet; Brown, Light Orange and Purple; Dark Brown, Orange Yellow and Blue; Crimson Lake, Greenish-Yellow and Black. *Four Colors.*—Black, Green, Dark Red, and Sienna; Scarlet, Dark Green, Lavender and Black; Ultramarine or Cobalt Blue, Vermillion, Bronze Green, and Lilac; Sienna, Blue, Red and Black.

NEWSPAPER MEASUREMENT.

Table showing number of ems of the different Newspaper Type in a line, the number of lines necessary to make 1.000 ems, and the length in inches. Also the number of ems in the regular length of (13 em Pica wide) columns.

	Agate.	Nonp.	Minion.	Brevier.	Bourg	Long Prim.
No. ems in line.	28 1/3	26	22 1/4	19 1/2	17 1/3	15 1/2
No. lines 1.000 ems.	35 1/3	38 1/2	45	51 1/3	57 2/3	64 1/2
No. In. 1.000 ems.	2 2/3	3 1/4	4 3/8	5 2/3	7 1/4	9

No. Columns.	No. ems in Col. Folio or Quarto.					
4	5.040	4.325	3.175	2.465	1.950	1.610
5	6.505	5.615	4.115	3.200	2.525	2.085
6	7.180	6.160	4.515	3.510	2.770	2.290
7	7.900	6.785	4.970	3.865	3.050	2.520
8	8.630	7.410	5.440	4.220	3.330	2.755
9	9.310	8.030	5.885	4.575	3.615	2.970

LEADS FOR NEWSPAPER.

Table showing the number of Leads 13 ems Pica long, contained in one pound and the number required to lead 1.000 ems of matter, together with the number of leads in a single column of matter regular size newspaper.

Size of Body Type to be Leaded with 6-to-Pica Leads.

	Agate.	Nonpareil	Minion.	Brevier.	Bourgeois.	Long Prim
No. Leads to lb.	60	60	60	60	60	60
" " 1.000 ems.	26	29	34	40	45	52
No. of Columns.	No. Leads in Col. Folio or Quarto.					
4	132	125	108	99	88	84
5	170	162	140	128	114	108
6	185	179	154	141	125	119
7	206	197	169	155	138	131
8	224	215	185	169	150	143
9	241	233	201	183	163	154

STANDARD SIZES OF NEWSPAPERS.

The following are the regular size, adopted by the auxiliary printers. We would advise parties planning new newspaper to adopt one of these sizes. The width of column is 13 ems.

No. Columns.	Size of Paper	Size of Form	Head Rule.	Col. Rule.
	FOLIO.			
5	20 by 26	17¾ by 23¾	11⅛	17¾
6	22 " 31	19¾ " 28¼	13⅜	19¾
7	24 " 35	21¾ " 33	15¾	21¾
8	26 " 40	23¾ " 37½	18	23¾
9	28 " 44	25¾ " 42	20¼	25¾
	QUARTO.			
4	22 by 31	18¾ by 29	8⅞	13¾
5	26 " 40	23¼ " 37	11⅛	17¾
6	30 " 44	27¾ " 41	13⅜	19¾
7	35 " 48	32½ " 45	15¾	21¾

STANDARD NEWSPAPER MEASURE.

The STANDARD newspaper measure, as recognized and now in general use, is 13 EMS PICA. ☞ *The Standard of Measurement* of all sizes of Type is the EM QUAD, *not the* letter m.

LEADS and SLUGS.

Leads are designated as "—to-Pica," the number being that fraction of a Pica which the lead is, viz: a 6-to-Pica lead is one-sixth of a Pica in thickness, or six 6-to-Picas are equal to one Pica; four 4-to-Picas one Pica, and so

with other sizes or thickness of leads.

SLUGS.—Leads of Nonpareil thickness and greater are called Slugs, viz: Nonpareil Slugs, Brevier Slugs, Pica Slugs, etc., a Pica is one-sixth of an inch nearly.

AVERAGE WEIGHT OF MATTER.

A piece of solid matter 13 Ems Pica wide and 6 inches long will weigh *about* 3⅜ pounds, but in order to allow for the sorts usually remaining in the case, 4⅜ pounds of Type would be required to set that amount of solid matter.

When the matter is to be *leaded* the weight of the Type may be reduced about one quarter.

A piece of solid matter 12 inches square will weigh about 40 pounds. One pound of Type will therefore, measure 3⅜ square inches. A piece of leaded matter 12 inches square will contain about 30 pounds of Type.

Leads Required for Newspaper and Book Work.

To lead 1 lb., of Pearl requires 6 ounces of 6-to-Pica leads, Agate 5½ ounces, Nonpareil 5 ounces, Minion 4½ ounces, Brevier 4 ounces. Bourgeois 3½ ounces, Long Primer 3 ounces, Small Pica 2¾ ounces, Pica 2½ ounces, English 2¼ ounces.

COLORED PRINTING-PAPER.

Are made either by adding coloring-matter to the pulp, or, when peculiarly brilliant colors are required, by painting or staining the paper. By the use of both processes a great variety of shades is produced. In printing on colored papers, it should be remembered that the appearance of the ink is affected by the color of the paper. When black letters appear on a colored surface-ground, they lose the intense hue they have when printed on white paper. On blue they are a failure; on orange (red lead) they are telling and brilliant, and assume a greenish bronze, on violet they are rich, in a Greenish-Yellow tone; the majority of yellows are weakened by black, which is thus rendered more intense. It should be remembered that—

1. Black Ink upon Red appears Dark Green.
2. Black Ink upon Orange, Bluish-black.
3. Black Ink upon Yellow is Black, with a slight tinge of Violet.
4. Black Ink upon Blue is Orange-gray.
5. Black Ink upon Green appears Reddish-gray.
6. Black Ink upon Violet appears Greenish-yellow-gray.

MARKS OR PUNCTUATIONS.

,	Comma.	¸	Cedilla.
;	Semicolon.	^	Caret.
:	Colon.	" "	Quotation Marks.
.	Period.	{	Brace.
—	Dash.	}	
?	Interrogation.	(	
!	Exclamation.	* * *	Ellipsis.
()	Parenthesis.	. . .	Ellipsis; also leaders.
[]	Brackets or Crotchets	———	Ellipsis.
-	Hyphen.	*	Asterisk.
'	Apostrophe.	†	Dagger, or Obelisk.
/	Acute Accent.	‡	Double Dagger.
\	Grave Accent.	§	Section.
^	Circumflex Accent.	‖	Parallels.
"	Circumflex or Tilde.	¶	Paragraph.
-	The Long or Macron.	☞	Index.
⏑	The Short or Breve.	*⁂* or ⁂	Asterism.
¨	Diæresis.		

CORRECTIONS OF THE PRESS.

ⅆ, or ꝺ, (dele) Delete, take out, or expunge.
ʔ Turn a reversed letter.
A space, or more space between words, letters, or lines.
⁀ Less space, or no space, between words or letters.
⌊ or ⌋ carry a word further to the left or to the right.
□ Indent.
⌐ Elevate a letter, word, or character that is sunk below the proper level.
¬ Sink or depress a letter, word, or character raised above the proper level.
| Shows that a portion of a paragraph projects laterally beyond the rest.
⊥ Directs attention to a quadrat or space which improperly appears.
×, or + directs attention to a broken or imperfect letter.
[Bring a words or words to the beginning of a line; also, make a new paragraph.
¶ Make a new paragraph.
— Change from Italic to Roman, or from Roman to Italic, as the case may be.
= Put in small capitals.
≡ Put in Capitals.

NOTE.—The other marks are self-explanatory; but the following *observations* used in correcting proof-sheets, require explanation:—

wf. Wrong font;—used when a character is of a wrong size or style; *tr.*, Transpose; *l. c.*, Lower-case; i, e., put in small or common letters a word or letter that has been printed in capitals or small capitals; *s. caps*, or *sm. c.*, Put in small capitals; *Qu.*, *Qy.*, or ? Query; *Out, s. c.* words are wanting, see copy.

FIRST PROOF FROM THE TYPE.

THE CROWNING OF PETRARCH.

Nothing can be conceived more affecting or noble than that ceremony. The superbe palaces and porticos by which had rolled the ivory chariots of Marius and and Caesar had long mouldered into dust. The laureled fasces, the golden eagles, the shouting Legions, the captives, and the pictured cities were indeed wanting to his victorious procession. The sceptre had passed away from Rome. But she still retained the mightier influence of an empire intellectual and was now to conter the prouder reward of an intellectual triumph. To the man who had extended the dominion of her ancient language who had erected the trophies of philosophy and imagination in the haunts of ignorance and fervency, whose captives were the he arts of admiring nations; enchained by the influence of his song-whose spoils were the *treasures* of ancient genius—the Eternal City offered the glorious and just tribute of her gratitude.

Amid the ruined monuments of ancient, and the infant eructions of modern art, he who had restored the broken link between thetwo ages of human civilization was crowned with the wreath which he had deserved from the moderns who owde to him their refinement —from the ancients who owed to him their fame Never was a coronation so august witnessed by westminister or Rheims.

MACAULAY.

A CORRECTED PROOF SHEET.

THE CROWNING OF PETRARCH.

Nothing can be conceived more affecting or noble than that ceremony. The superbe palaces and portico's by which had rolled the ivory chariots of Marius ~~and~~ and Cæsar had long mouldered into dust. The laureled fasces, the golden eagles, the shouting Legions, the captives, and the pictured cities were indeed wanting to his victorious procession. The sceptre had passed away from Rome. But she still retained the mightier influence of an empire intellectual and was now to confer the ~~prouder~~ reward of an intellectual triumph. To the man who had extended the dominion of her ancient language who had erected the trophies of philosophy and imagination in the haunts of ignorance and ferveney, whose captives were the hearts of admiring nations; enchained by the influence of his song, whose spoils were the *treasures* of ancient genius the Eternal City offered the glorious and just tribute of her gratitude.

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MACAULAY.

rescued from obscurity and decay

PROOF SHEET CORRECTED.

THE CROWNING OF PETRARCH.

Nothing can be conceived more affecting or noble than that ceremony. The superb palaces and porticos by which had rolled the ivory chariots of Marius and Cæsar had long mouldered into dust. The laureled fasces, the golden eagles, the shouting legions, the captives, and the pictured cities were indeed wanting to his victorious procession. The scepter had passed away from Rome. But she still retained the mightier influence of an intelleectual empire and was now to confer the prouder reward of an intellectual triumph. To the man who had extended the dominion of her ancient language who had erected the trophies of philosophy and imagination in the haunts of ignorance and ferocity, whose captives were the hearts of admiring nations, enchained by the influence of his song—whose spoils were the treasures of ancient genius rescued from obscurity and decay—the "Eternal City" offered the just and glorious tribute of her gratitude. Amid the ruined monuments of ancient, and the infant erections of modern art, he who had restored the broken link between the two ages of human civilization was crowned with the wreath which he had deserved from the moderns who owed to him their refinement,—from the ancients who owed to him their fame. Never was a coronation so august witnessed by Westminister or Rheims.

Macauley.

COMPLETE TABLE OF SIGNATURES.

EIGHT VO.

1	1	A	369	47	2 W	729	92	4 R
9	2	B	377	48	2 X	737	93	4 S
17	3	C	385	49	2 Y	745	94	4 T
25	4	D	393	50	2 Z	753	95	4 U
33	5	E	401	51	3 A	761	96	4 V
41	6	F	409	52	3 B	769	97	4 W
49	7	G	417	53	3 C	777	98	4 X
57	8	H	425	54	3 D	785	99	4 Y
65	9	I	433	55	3 E	793	100	4 Z
73	10	K	441	56	3 F	801	101	5 A
81	11	L	449	57	3 G	809	102	5 B
89	12	M	457	58	3 H	817	103	5 C
97	13	N	465	59	3 I	825	104	5 D
105	14	O	473	60	3 K	833	105	5 E
113	15	P	481	61	3 L	841	106	5 F
121	16	Q	489	62	3 M	849	107	5 G
129	17	R	497	63	3 N	857	108	5 H
137	18	S	505	64	3 O	865	109	5 I
145	19	T	513	65	3 P	873	110	5 K
153	20	U	521	66	3 Q	881	111	5 L
161	21	V	529	67	3 R	889	112	5 M
169	22	W	537	68	3 S	897	113	5 N
177	23	X	545	69	3 T	905	114	5 O
185	24	Y	553	70	3 U	913	115	5 P
193	25	Z	561	71	3 V	921	116	5 Q
201	26	2 A	569	72	3 W	929	117	5 R
209	27	2 B	577	73	3 X	937	118	5 S
217	28	2 C	585	74	3 Y	945	119	5 T
225	29	2 D	593	75	3 Z	953	120	5 U
233	30	2 E	601	76	4 A	961	121	5 V
241	31	2 F	609	77	4 B	969	122	5 W
249	32	2 G	617	78	4 C	977	123	5 X
257	33	2 H	625	79	4 D	985	124	5 Y
265	34	2 I	633	80	4 E	993	125	5 Z
273	35	2 K	641	81	4 F	1001	126	6 A
281	36	2 L	649	82	4 G	1009	127	6 B
289	37	2 M	657	83	4 H	1017	128	6 C
297	38	2 N	665	84	4 I	1025	129	6 D
305	39	2 O	673	85	4 K	1033	130	6 E
313	40	2 P	681	86	4 L	1041	131	6 F
321	41	2 Q	689	87	4 M	1049	132	6 G
329	42	2 R	697	88	4 N	1057	133	6 H
337	43	2 S	705	89	4 O	1065	134	6 I
345	44	2 T	713	90	4 P	1073	135	6 K
353	45	2 U	721	91	4 Q	1081	136	6 L
361	46	2 V						

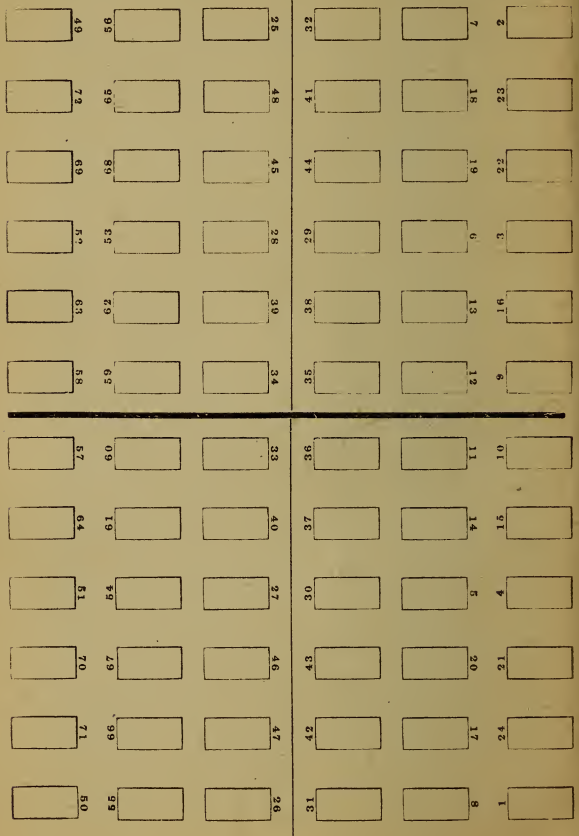
1	1	A	301	26	2 A	601	51	3 A
5	1*	A^2	305	26*	$2 A^2$	605	51*	$3 A^2$
13	2	B	313	27	2 B	613	52	3 B
17	2*	B^2	317	27*	$2 B^2$	617	52*	$3 B^2$
25	3	C	325	28	2 C	625	53	3 C
29	3*	C^2	329	28*	$2 C^2$	629	53*	$3 C^2$
37	4	D	337	29	2 D	637	54	3 D
41	4*	D^2	341	29*	$2 D^2$	641	54*	$3 D^2$
49	5	E	349	30	2 E	649	55	3 E
53	5*	E^2	353	30*	$2 E^2$	653	55*	$3 E^2$
61	6	F	361	31	2 F	661	56	3 F
65	6*	F^2	365	31*	$2 F^2$	665	56*	$3 F^2$
73	7	G	373	32	2 G	673	57	3 G
77	7*	G^2	377	32*	$2 G^2$	677	57*	$3 G^2$
85	8	H	385	33	2 H	685	58	3 H
89	8*	H^2	389	33*	$2 H^2$	689	58*	$3 H^2$
97	9	I	397	34	2 I	697	59	3 I
101	9*	I^2	401	34*	$2 I^2$	701	59*	$3 I^2$
109	10	K	409	35	2 K	709	60	3 K
113	10*	K^2	413	35*	$2 K^2$	713	60*	$3 K^2$
121	11	L	421	36	2 L	721	61	3 L
125	11*	L^2	425	36*	$2 L^2$	725	61*	$3 L^2$
133	12	M	433	37	2 M	733	62	3 M
137	12*	M^2	437	37*	$2 M^2$	737	62*	$3 M^2$
145	13	N	445	38	2 N	745	63	3 N
149	13*	N^2	449	38*	$2 N^2$	749	63*	$3 N^2$
157	14	O	457	39	2 O	757	64	3 O
161	14*	O^2	461	39*	$2 O^2$	761	64*	$3 O^2$
169	15	P	469	40	2 P	769	65	3 P
173	15*	P^2	473	40*	$2 P^2$	773	65*	$3 P^2$
181	16	Q	481	41	2 Q	781	66	3 Q
185	16*	Q^2	485	41*	$2 Q^2$	785	66*	$3 Q^2$
193	17	R	493	42	2 R	793	67	3 R
197	17*	R^2	497	42*	$2 R^2$	797	67*	$3 R^2$
205	18	S	505	43	2 S	805	68	3 S
209	18*	S^2	509	43*	$2 S^2$	809	68*	$3 S^2$
217	19	T	517	44	2 T	817	69	3 T
221	19*	T^2	521	44*	$2 T^2$	821	69*	$3 T^2$
229	20	U	529	45	2 U	829	70	3 U
233	20*	U^2	533	45*	$2 U^2$	833	70*	$3 U^2$
241	21	V	541	46	2 V	841	71	3 V
245	21*	V^2	545	46*	$2 V^2$	845	71*	$3 V^2$
253	22	W	553	47	2 W	853	72	3 W
257	22*	W^2	557	47*	$2 W^2$	857	72*	$3 W^2$
265	23	X	565	48	2 X	865	73	3 X
269	23*	X^2	569	48*	$2 X^2$	869	73*	$3 X^2$
277	24	Y	577	49	2 Y	877	74	3 Y
281	24*	Y^2	581	49*	$2 Y^2$	881	74*	$3 Y^2$
289	25	Z	589	50	2 Z	889	75	3 Z
293	25*	Z^2	593	50*	$2 Z^2$	893	75*	$3 Z^2$

16MO AND 24MO.

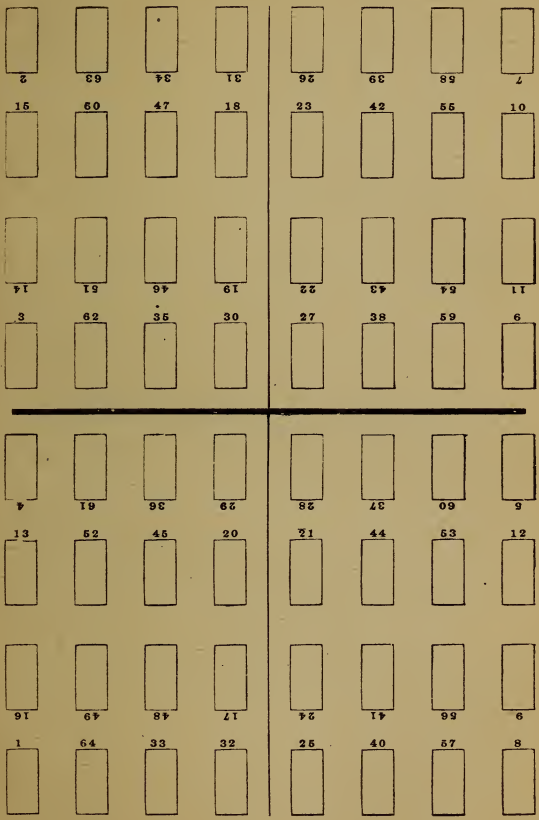
16 MO.			*24 MO.*					
1	1	A	**1**	1	A	401		R^2
17	2	B	9	1*		409	18	S
33	3	C	17		A^2	417	18*	
49	4	D	25	2	B	425		S^2
65	5	E	33	2*		433	19	T
81	6	F	41		B^2	441	19*	
97	7	G	49	3	C	449		T^2
113	8	H	57	3*		457	20	U
129	9	I	65		C^2	465	20*	
145	10	K	73	4	D	473		U^2
161	11	L	81	4*		481	21	V
177	12	M	89		D^2	489	21*	
193	13	N	97	5	E	497		V^2
209	14	O	105	5*		505	22	W
225	15	P	113		E^2	513	22*	
241	16	Q	121	6	F	521		W^2
257	17	R	129	6*		529	23	X
273	18	S	137		F^2	537	23*	
289	19	T	145	7	G	545		X^2
305	20	U	153	7*		553	24	Y
321	21	V	161		G^2	561	24*	
337	22	W	169	8	H	569		Y^2
353	23	X	177	8*		577	25	Z
369	24	Y	185		H^2	585	25*	
385	25	Z	193	9	I	593		Z^2
401	26	2 A	201	9*		601	26	2 A
417	27	2 B	209		I^2	609	26*	
433	28	2 C	217	10	K	617		$2\ A^2$
449	29	2 D	225	10*		625	27	2 B
465	30	2 E	233		K^2	633	27*	
481	31	2 F	241	11	L	641		$2\ B^2$
497	32	2 G	249	11*		649	28	2 C
513	33	2 H	257		L^2	657	28*	
529	34	2 I	265	12	M	665		$2\ C^2$
545	35	2 K	273	12*		673	29	2 D
561	36	2 L	281		M^2	681	29*	
577	37	2 M	289	13	N	689		$2\ D^2$
593	38	2 N	297	13*		697	30	2 E
609	39	2 O	305		N^2	705	30*	
625	40	2 P	313	14	O	713		$2\ E^2$
641	41	2 Q	321	14*		721	31	2 F
657	42	2 R	329		O^2	729	31*	
673	43	2 S	337	15	P	737		$2\ F^2$
689	44	2 T	345	15*		745	32	2 G
705	45	2 U	353		P^2	753	32*	
721	46	2 V	361	16	Q	761		$2\ G^2$
737	47	2 W	369	16*		769	33	2 H
753	48	2 X	377		Q^2	777	33*	
769	49	2 Y	385	17	R	785		$2\ H^2$
785	50	2 Z	393	17*		793	34	2 I

IMPOSITION OF FORMS.

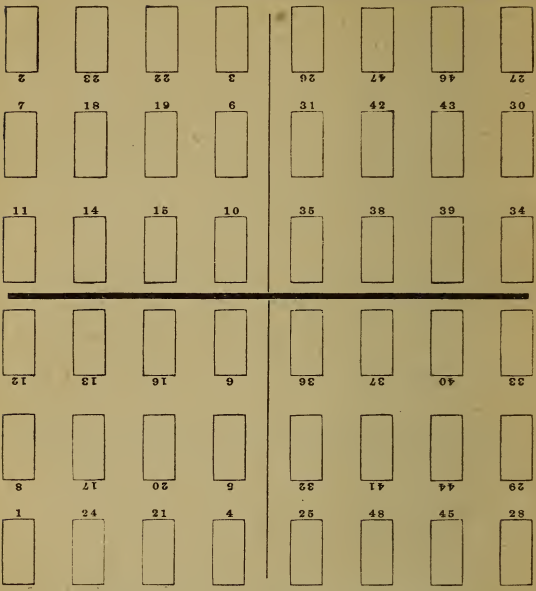
A Half-Sheet of Seventy-Twos, with Three Signatures.



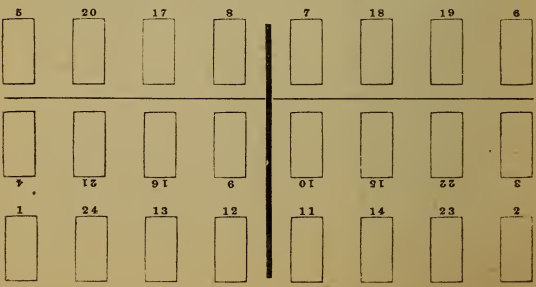
A HALF-SHEET of SIXTY-FOURS.



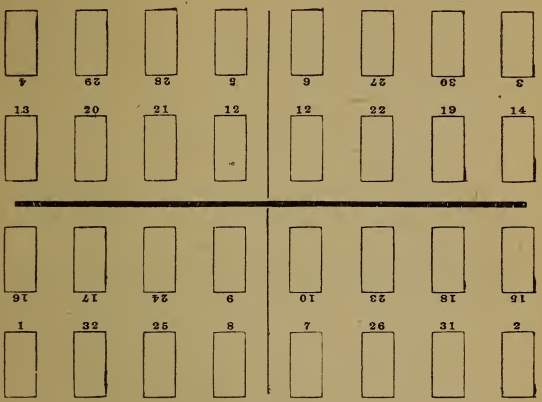
A HALF-SHEET of FORTY-EIGHTS, with Two Signatures.



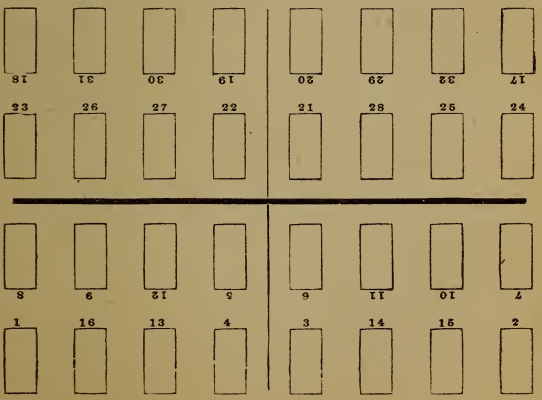
A HALF-SHEET of TWENTY-FOURS, without Cutting.



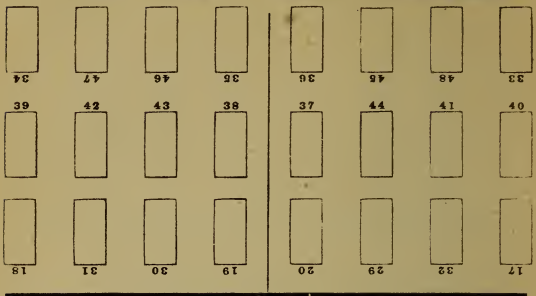
A Common Quarter-Sheet of Sixty-Fours.



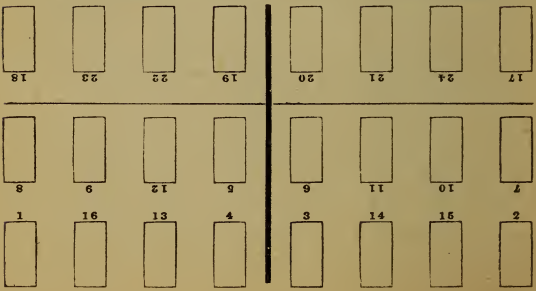
A Quarter-Sheet of Sixty-Fours. with Two Signatures.



A HALF-SHEET of FORTY-EIGHTS, with Three Signatures.

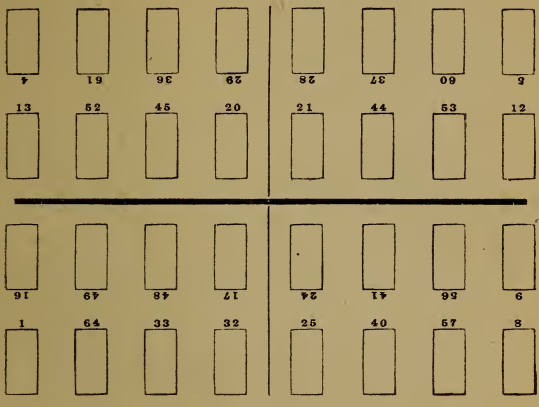


A HALF-SHEET of TWENTY-FOURS, without Inset.

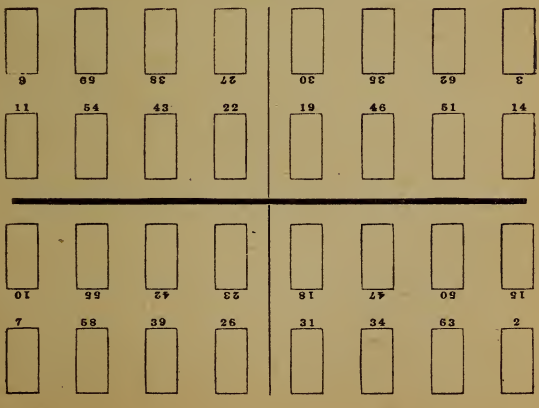


A Sheet of Thirty-Twos.

Outer Form.

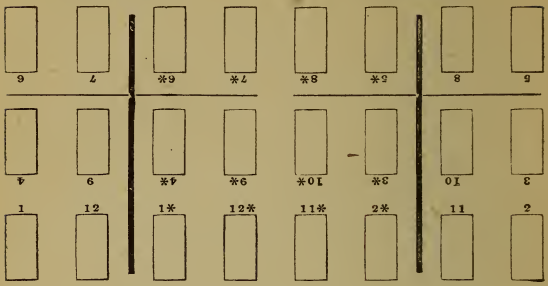


Inner Form.

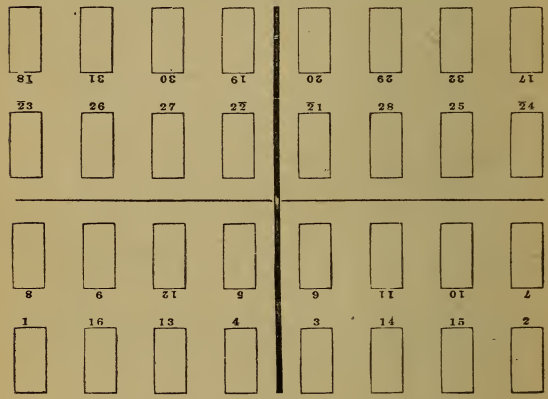


Two Half-Sheets of Twelves Worked Together.

Outer Form. *Inner Form.*



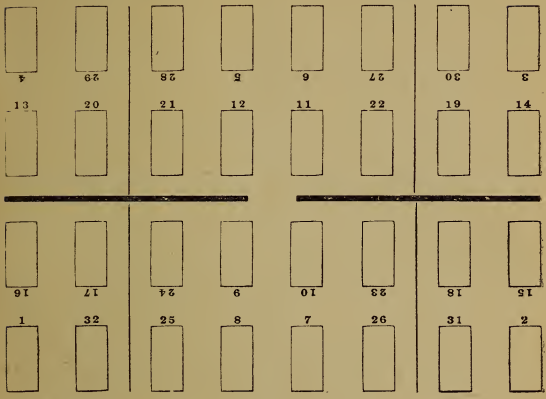
A Half-Sheet of Thirty-Twos with Two Signatures.



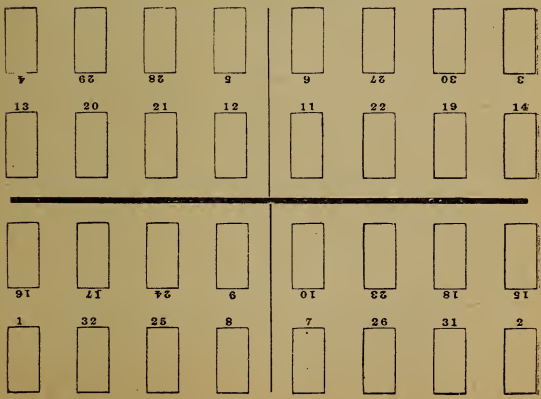
Six Page Leaflet. First Page to the Left.

A Sheet of Sixteens, With one Signature.

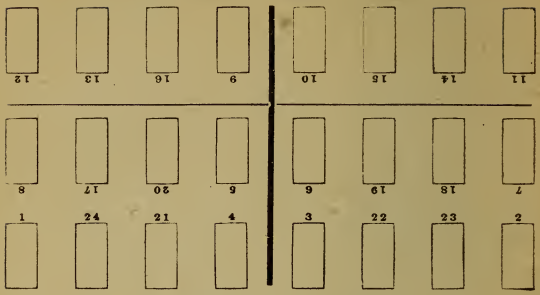
Outer Form. *Inner Form.*



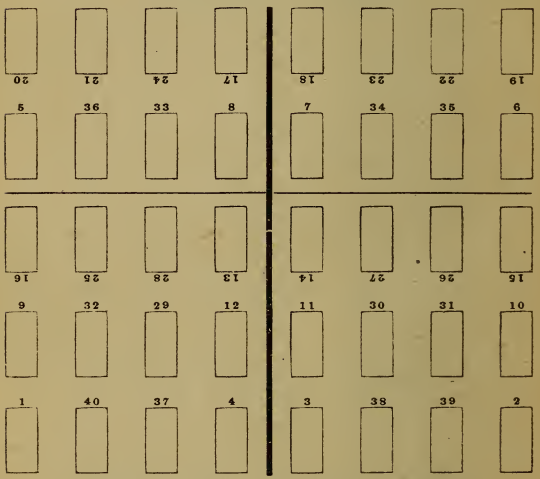
A Half-Sheet of Thirty-Twos.



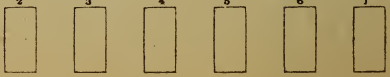
A Half-Sheet of Twenty-Fours.



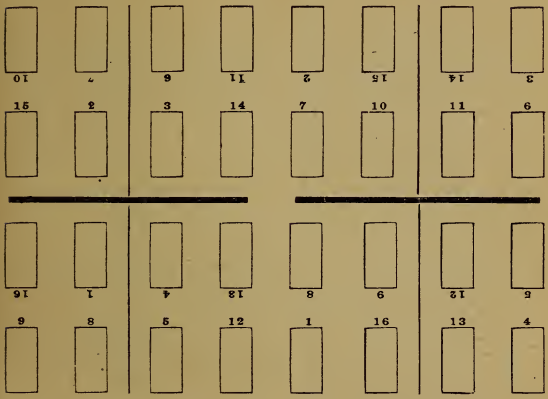
A Half-Sheet of Forties.



Six Page Leaflet. First Page to the Right.

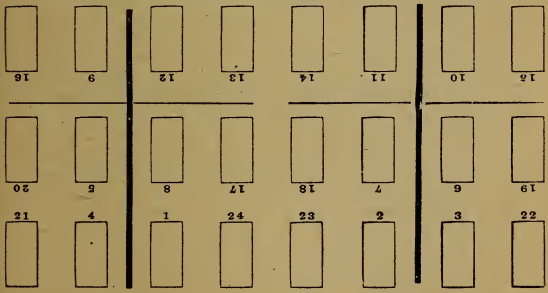


Form of Sixteens with first four pages placed in center.



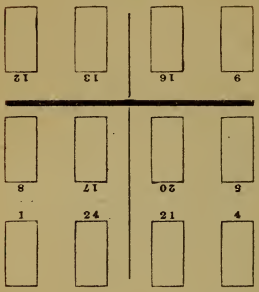
A Half-Sheet of Sixteens.

A SHEET OF TWELVES, Imposed From the Center.

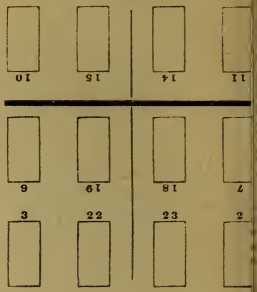


Six Page Leaflet. First Page in Center.

Outer Form of a Sheet of Twelves.

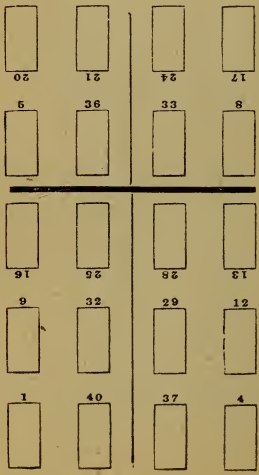


Inner Form of a Sheet of Twelves.

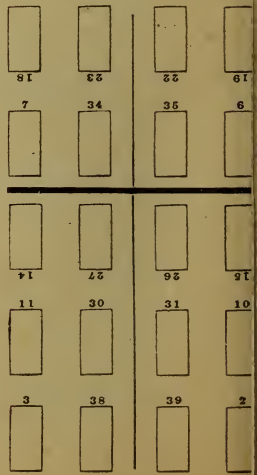


A Sheet of Twenties.

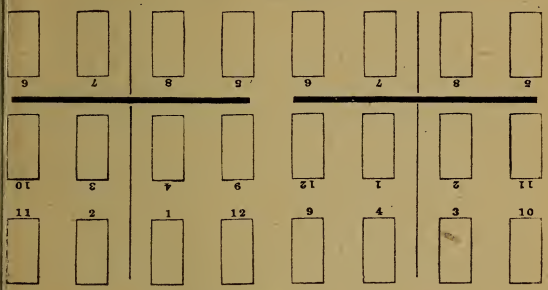
Outer Form.



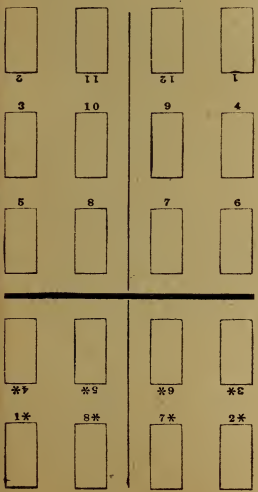
Inner Form.



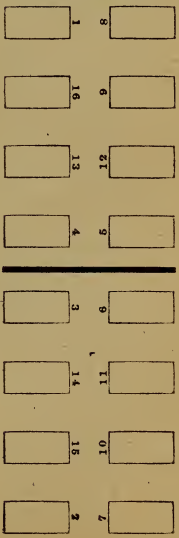
Different Method of Imposing Half-Sheets of Twelves, from the Center.



A Half-Sheet of Twenties, with Two Signatures.

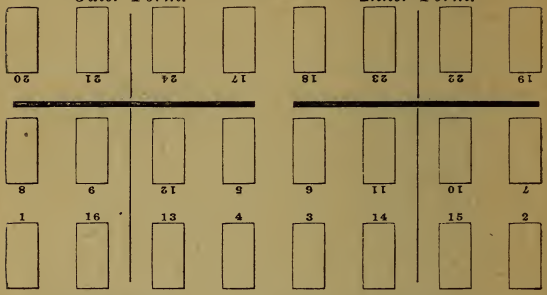


A Half-Sheet of Long Sixteens.

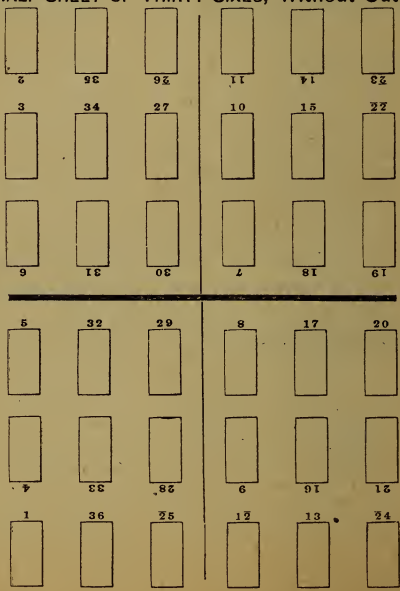


A Sheet of Twelves With Two Signatures.

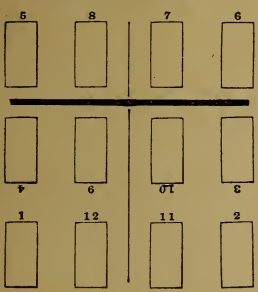
Outer Form. *Inner Form.*



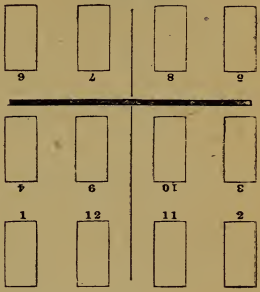
A Half-Sheet of Thirty-Sixes, Without Cutting.



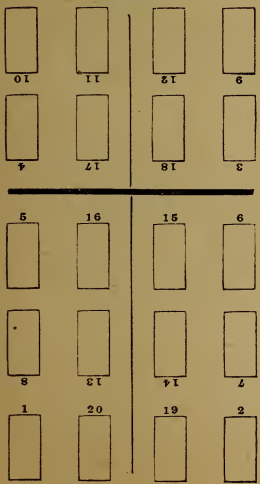
Half-Sheet of Twelves, without Cutting.



A Common Half-Sheet of Twelves.

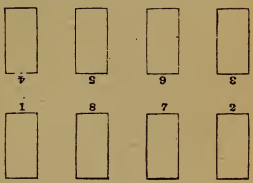


Forms of 20s, with Inset-Sheet Turning Crosswise of the Pages.

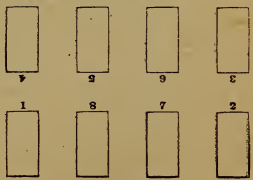


Quarto in Two Forms.

Outside. *Inside.*

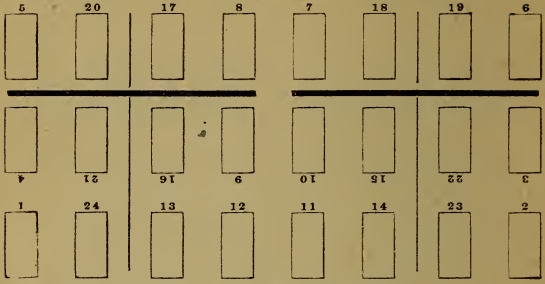


Eights, Work and Turn.

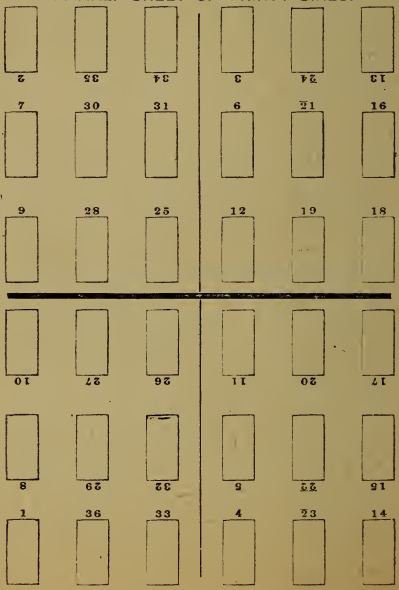


A Sheet of Twelves Without Cutting.

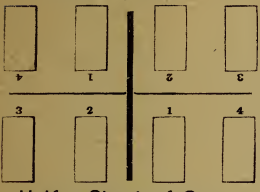
Outer Form. *Inner Form.*



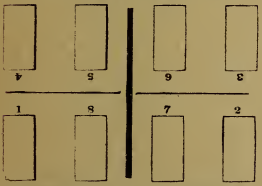
A Half-Sheet of Thirty-Sixes.



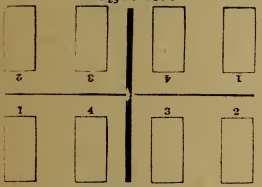
Two Quarters Sheet of Octavo, Imposed from the Center.



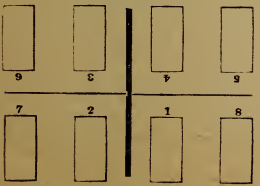
Half a Sheet of Common Octavo.



Two Quarters of a Sheet of Octavo worked Together.

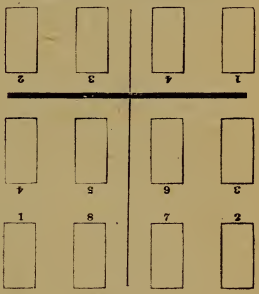


A Half-Sheet of Octavo, Imposed from the Center.



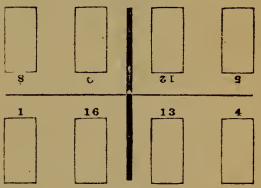
A Half-Sheet of Twelves, With Two Signatures.

4 pages of other matter.

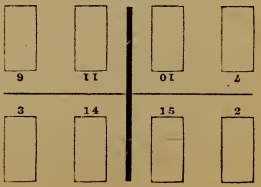


A Sheet of Common Octavo.

Outer Form.

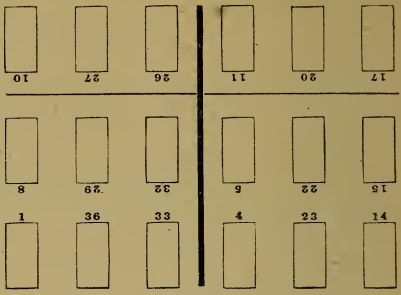


Inner Form.

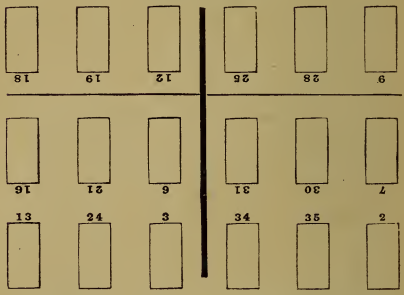


A Sheet of Eighteens, with One Signature.

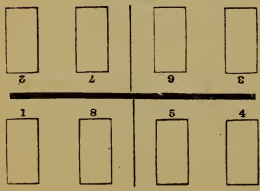
Outer Form.



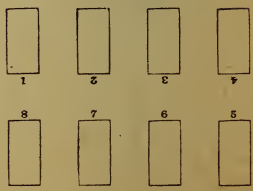
Inner Form.



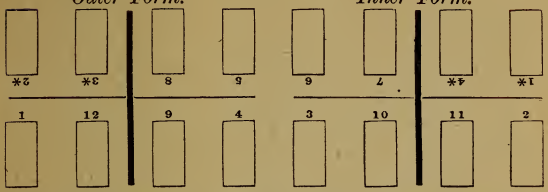
Octavo.—Sheet turning lengthwise of the pages.



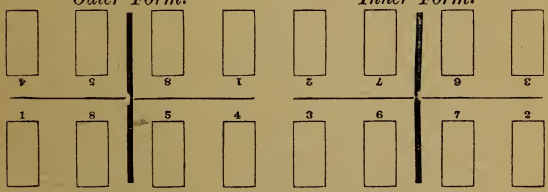
Eight page leaflet. First page to the left.



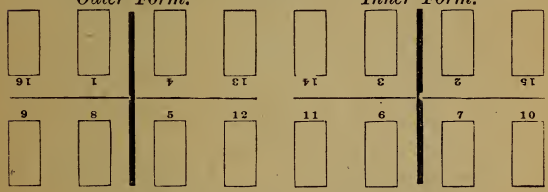
A Sheet of Octavo, 12 of the Work and 4 of other Matter.



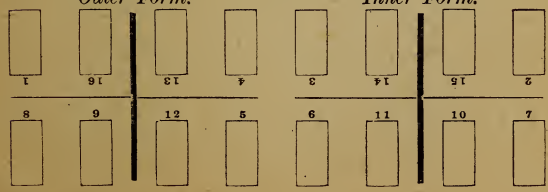
Two Half-Sheets of Common Octavo Worked Together.



A Sheet of Octavo, Imposed from the Center.

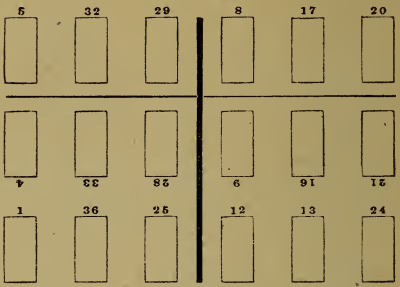


A Sheet of Octavo, of Hebrew Work.

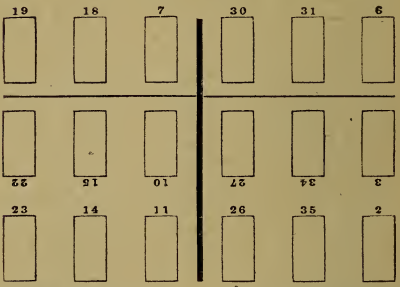


A Sheet of Eighteens to be Folded Together.

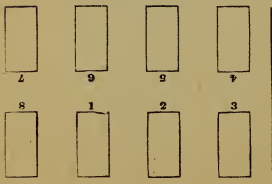
Outer Form.



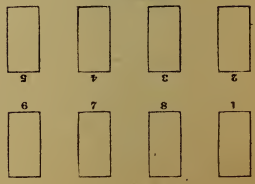
Inner Form.



Eight page leaflet. First Page next to the left.

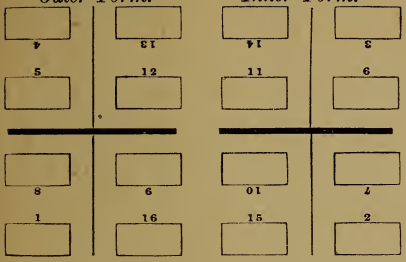


Eight page leaflet. First page to the right.

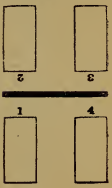


A Sheet of Octavo, the Broad Way.

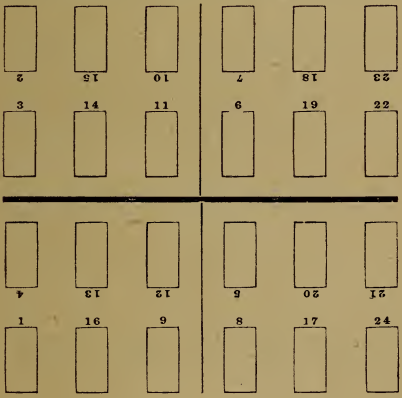
Outer Form. *Inner Form.*



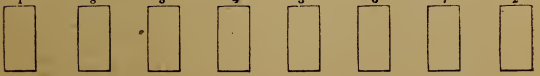
Half a Sheet of Common Quarto.



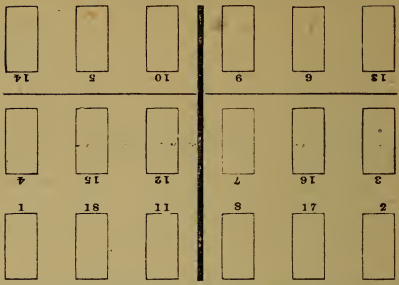
A Half-Sheet of Twenty Fours, without Inset.



Octavo..—Eight pages in a line.

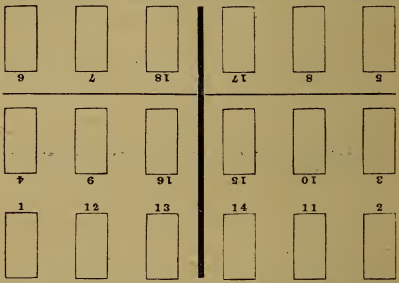


A Half-Sheet of Eighteens.



When the paper is worked off, transpose the pages 11 and 8 in the place of 7 and 12, and pages 7 and 12 in place of 11 and 8.

A Half-Sheet of Eighteens, without Transposition.



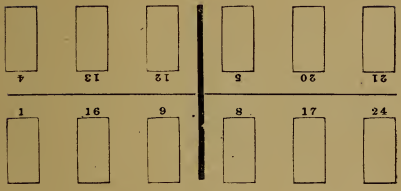
This form of imposition will give three single leaves when the sheet is cut, and should therefore be avoided where possible.

Broad Eights, in Two Forms.

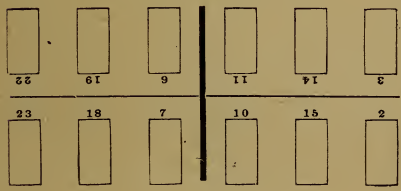
Outside. *Inside.*

A SHEET OF LONG TWELVES.

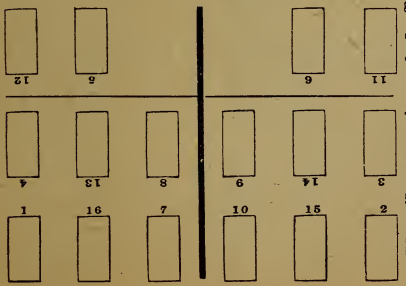
Outer Form.



Inner Form.



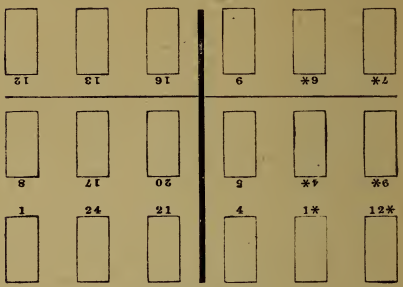
A HALF-SHEET OF EIGHTEENS, (Containing 16 pages).



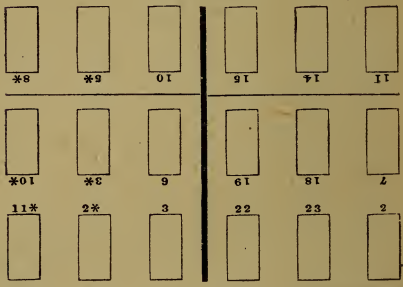
When the paper is worked off, transpose the pages 7 and 10 in the place of 9 and 8, and pages 9 and 8 in the place of 7 and 10.

A Sheet of Eighteens, with Two Signatures.

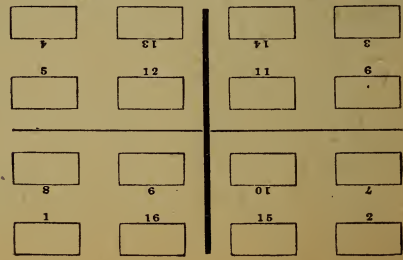
Outer Form.



Inner Form.

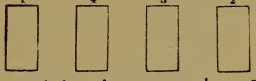


A Half-Sheet of Sixteens, The Broad Way.



QUARTO.
Sheet turning lengthwise of the page.

QUARTO.



Sheet turning crosswise of the pages.

Convenient for Leaflets, Price Lists etc.

AMERICAN AND GERMAN TYPE.

GERMAN NAME.	AMERICAN NAME.	Points.	No. of ems per ft. in Germany.	No. of ems per ft. in America.
1/8 petit	American	1	811	855
1/8 cicero	German	1½	541	570
1/4 petit	Saxon	2	405	427
1/4 cicero	Brilliant	3	270	285
Diamant	Diamond	4	203	202
Perl	Agate	5	162	160
Nonpareille	Nonpariel	6	135	143
Colonel	Brevier	7	115	113
Petit	Bourgeois	8	101	101
Borgis	Long-primer	9	90	90
Garmond	Small-pica	10	81	80
Cicero	Pica	12	68	71
Mittel	English	14	58	57
Tertia	Great-primer	16	51	50
Doppelborgis	Paragon	18	45	45
Text	Double S. pica	20	41	40
Doppelcicero	Double pica	24	34	36
Doppelmittel	" Columbian	28	29	28
Kleine canon	" Gr't Primer	32	25	25
Canon or dreicicero	" Paragon	36	23	22
Grobe canon	Meridian	40	20	20
3½ cicero	3 line Columbian	42	19	19
Kleine missal or viercicero	Canon	48	17	18
4½ cicero	3 line Paragon	54	15	15
Grosse missal	6 " S. pica	60	14	13
Kleine sabon	4 " Paragon	72	11	11

DECIMAL APPROXIMATIONS FOR FACILITATING CALCULATIONS.

Avoirdupois pounds	multiplied by	.009	equals	Cwts.
" "	"	.3045	"	Tons.
Lineal feet	"	.00019	"	Miles.
" yards	"	.000568	"	"
Square Inches.	"	.007	"	Square feet.
" Feet.	"	.111	"	" Yds.
" Yards.	"	.0002067	"	" Acres
Circular Inches	"	.00546	"	" Feet.
Cylindrical "	"	.0001546	"	Cubic "
" Feet	"	.02909	"	" yds.
Cubic Inches	"	.00058	"	" Feet.
" Feet.	"	.03704	"	" Yds.
" "	"	.6232	"	Imper'l g'ls.
" Inches	"	.003607	"	" "
Cylindrical Feet	"	4.895	"	" "
" Inches	"	.002832	"	" "
Cubic "	"	.263	"	lbs. Avoir. / Cast-Iron.
" "	"	.281	"	Wr'gt Iron.
" "	"	.283	"	Steel.
" "	"	.3225	"	Copper.
" "	"	.3037	"	Brass.
" "	"	.26	"	Zinc.
" "	"	.4103	"	Lead.
" "	"	.2636	"	Tin.
" "	"	.4908	"	Mercury.
Cylindrical Inches	"	.2065	"	Cast-Iron.
" "	"	.2168	"	Wr'gt Iron.
" "	"	.2223	"	Steel.
" "	"	.2533	"	Copper.
" "	"	.2385	"	Brass.
" "	"	.2042	"	Zinc.
" "	"	.3223	"	Lead.
" "	"	.207	"	Tin.
" "	"	.3854	"	Mercury.
Diameter of a ○	multiplied	3.1416	"	Circum.
" " "	"	.8862	"	Side of=sq.
" " "	"	.7071	=	Side of inscribed".
" Sphere "	"	.806	"	Dim. of = Cube.
" " "	"	.6667	"	Length of=cyl'der
Square of diameter	×	.7854	"	Area of a Circle.
Circum. of a Circle	"	.31831	"	Diameter.
Side of a square	"	1.128	"	Diam of = Circle.
Sq. Root of Area	"	1.12837	"	" " Square.
Sq. of the diam. of a sphere.	"	3.1416	"	Convex surface.
Cube. do. do.	"	.5236	"	Solidity.
183.346 Circular inches			"	1 Square foot.

2.200	Cylindrical inches		equals	1 Cubic foot.
Acres		× .4840	"	Square yards.
Links		" .22	"	Yards.
"		" .66	"	Feet.
Feet		" 1.5	"	Links.
Width in chains		" 8.	"	Acres per Mile.
Cubic feet		" 7.48	"	U. S. gallons.
"	Inches	" .004329	"	U. S. "
Cylindrical feet.		" 5.874	"	U. S. "
"	Inches	" .0034	"	U. S. "
U. S. gallons		.13367	"	Cubic feet.
U. S. gallons		" 231.	"	Cubic Inches.
Cubic feet		" .8036	"	U. S. Bushels.
"	Inches	" .000466	"	U. S. Bushels.
U. S. Bushels		" .0495	"	Cubic yards.
U. S. "		" 1.2446	"	" feet.
U. S. "		"2150.42	"	" inches.
Cylindrical feet of water		" 6.	"	U. S. gallons.
Cubic feet of water.		" 62.5	"	lbs avoirdupois.
"	inches	" .03617	"	" "
Cylindrical feet.		" 49.11	"	" "
"	inches.	" .02842	"	" "
13.44	U. S. gal.		"	1 Cwt.
268.8	U. S. "		"	1 Ton.
1.8	Cubic feet.		"	1 Cwt.
35.88	" "		"	1 Ton.
Square Inches		" 1.273	"	Circular Inches.

STEAM AND WATER.

Pounds of water, at 62° F.		× 0.016037	equal	Cubic feet.
" " "		" 0.1199	"	Gallons.
" " "		" 1.2	"	Imperial gals.
Tons " "		" 35.90	"	Cubic feet.
Gallons per second	×	474.08	equal	Cu. feet per hour.
Gallons per minute	"	7.9	"	" " " " "
Cu. feet per second	"	2.222	"	Cu. yds. per minute.
" " " "	"	133.333	"	" " " hour.
Cu. feet per minute	"	2.222	"	" " " "

Feet of water at 52.3° F. × 0.8823 equals inches of mercury at 32° F.

Atmospheres	×	14.706	equals	pounds per square inch.
"		" 2105.664	"	pounds per square foot.
"		" 8.503	"	tons per square yard.
"		" 29.922	"	inches of mercury.
"		" 33.96	"	feet of water at 52.3° F.

TO CONVERT THE WEIGHT OF—

Wrought-Iron	into Cast-Iron	multiplied by	0.928
	Steel.	" "	1.014
	Zinc.	" "	0.918
	Brass.	" "	1.082
	Copper.	" "	1.144
	Lead.	" "	1.468

TABLE OF DECIMAL PARTS OF A FOOT FOR EACH 1-32 OF AN INCH.

Inch.	0	1	2	3	4	5	6	7	8	9	10	11
0	.0000	.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167
1-32	.0026	.0859	.1693	.2526	.3359	.4193	.5026	.5859	.6693	.7526	.8359	.9193
1-16	.0052	.0885	.1719	.2552	.3385	.4219	.5052	.5885	.6719	.7552	.8385	.9219
3-32	.0078	.0911	.1745	.2578	.3411	.4245	.5078	.5911	.6745	.7578	.8411	.9245
1/8	.0104	.0938	.1772	.2604	.3438	.4271	.5104	.5938	.6771	.7604	.8438	.9271
5-32	.0130	.0964	.1797	.2630	.3464	.4297	.5130	.5964	.6797	.7630	.8464	.9297
3-16	.0156	.0990	.1823	.2656	.3490	.4323	.5156	.5990	.6823	.7656	.8490	.9323
7-32	.0182	.1016	.1849	.2682	.3516	.4349	.5182	.6016	.6849	.7682	.8516	.9349
1/4	.0208	.1042	.1875	.2708	.3542	.4375	.5208	.6042	.6875	.7708	.8542	.9375
9-32	.0234	.1068	.1901	.2734	.3568	.4401	.5234	.6068	.6901	.7734	.8568	.9401
5-16	.0260	.1094	.1927	.2760	.3594	.4427	.5260	.6094	.6927	.7760	.8594	.9427
11-32	.0286	.1120	.1953	.2786	.3620	.4453	.5286	.6120	.6953	.7786	.8620	.9453
3/8	.0313	.1146	.1979	.2813	.3646	.4479	.5313	.6146	.6979	.7813	.8646	.9479
13-32	.0339	.1172	.2005	.2839	.3672	.4505	.5339	.6172	.7005	.7839	.8672	.9505
7-16	.0365	.1198	.2031	.2865	.3698	.4531	.5365	.6198	.7031	.7865	.8698	.9531
15-32	.0391	.1224	.2057	.2891	.3724	.4557	.5391	.6224	.7057	.7891	.8724	.9557
1/2	.0417	.1250	.2083	.2917	.3750	.4583	.5417	.6250	.7083	.7917	.8750	.9583
17-32	.0443	.1276	.2109	.2943	.3776	.4609	.5443	.6276	.7109	.7943	.8776	.9609
9-16	.0469	.1302	.2135	.2969	.3802	.4635	.5469	.6302	.7135	.7969	.8802	.9635
19-32	.0495	.1328	.2161	.2995	.3828	.4661	.5495	.6328	.7161	.7995	.8828	.9661
5/8	.0521	.1354	.2188	.3021	.3854	.4688	.5521	.6354	.7188	.8021	.8854	.9688
21-32	.0547	.1380	.2214	.3047	.3880	.4714	.5547	.6380	.7214	.8047	.8880	.9714
11-16	.0573	.1406	.2240	.3073	.3906	.4740	.5573	.6406	.7240	.8073	.8906	.9740
23-32	.0599	.1432	.2266	.3099	.3932	.4766	.5599	.6432	.7266	.8099	.8932	.9766
3/4	.0625	.1458	.2292	.3125	.3958	.4792	.5625	.6458	.7292	.8125	.8958	.9792
25-32	.0651	.1484	.2318	.3151	.3984	.4818	.5651	.6484	.7318	.8151	.8984	.9818

TABLE OF DECIMAL PARTS OF A FOOT FOR EACH 1-32 OF AN INCH. (Continued).

Inch.	0	1	2	3	4	5	6	7	8	9	10	11
13-16	.0677	.1510	.2344	.3177	.4010	.4844	.5677	.6510	.7344	.8177	.9010	.9844
27-32	.0703	.1536	.2370	.3203	.4036	.4870	.5703	.6536	.7370	.8203	.9036	.9870
7/8	.0729	.1563	.2396	.3229	.4063	.4896	.5729	.6563	.7396	.8229	.9063	.9896
29-32	.0755	.1589	.2422	.3255	.4089	.4922	.5755	.6589	.7422	.8255	.9089	.9922
15-16	.0781	.1615	.2448	.3281	.4115	.4948	.5781	.6615	.7448	.8281	.9115	.9948
31-32	.0807	.1641	.2474	.3307	.4141	.4974	.5807	.6641	.7474	.8307	.9141	.9974

DECIMAL EQUIVALENTS of 8ths, 16ths, 32ds, and 64ths of an INCH.

Fractions of an Inch.	Decimals of an inch.	Fractions of an Inch.	Decimals of an Inch.	Fractions of an Inch.	Decimals of an Inch.	Fractions of an Inch.	Decimals of an Inch.
		1/4	.25	1/2	.5	3/4	.75
1-64	.015625	17-64	.265625	33-64	.515625	49-64	.765625
1-32	.03125	9-32	.28125	17-32	.53125	25-36	.78125
3-64	.046875	19-64	.296875	35-64	.546875	51-64	.796875
1-16	.0625	5-16	.3125	9-16	.5625	13-16	.8125
5-64	.078125	21-64	.328125	37-64	.578125	53-64	.828125
3-32	.09375	11-32	.34375	19-32	.59375	27-32	.84375
7-64	.109375	23-64	.359375	39-64	.609375	55-64	.859375
1/8	.125	3/8	.375	5/8	.625	7/8	.875
9-64	.140625	25-64	.390625	41-64	.640625	57-64	.890625
5-32	.15625	13-32	.40625	21-32	.65625	29-32	.90625
11.64	.171875	27-64	.421895	43-64	.671875	59-64	.921875
3-16	.1875	7-16	.4375	11-16	.6875	15-16	.9375
13 64	.203125	29-64	.453125	45-64	.703125	61-64	.953125
7-32	.21875	15-32	.46875	23-32	.71875	31-32	.96875
15-64	.234375	31-64	.484375	47-64	.734375	63-64	.984375

DECIMAL PARTS OF A POUND (16 oz) REDUCED TO THEIR VALUE IN OUNCES.

Ounces.	100th Parts.	Ounces.	100th Parts	Ounces	100th Parts	Ounces	100th Parts
16	1.00	12	.75	8	.50	4	.25
15½	.96	11½	.72	7½	.46	3½	.22
15	.94	11	.69	7	.43	3	.19
14½	.90	10½	.65	6½	.40	2½	.15
14	.87	10	.62	6	.37	2	.12
13½	.84	9½	.59	5½	.34	1½	.09
13	.81	9	.56	5	.31	1	.06
12½	.78	8½	.53	4½	.28		

Equivalents of Carats in Decimal parts, unity being Twenty-Four Carats.

Carats.	Decimals.	Carats.	Decimals.	Carats.	Decimals
1	0.042	9	0.375	17	0.707
2	0.033	10	0.417	18	0.750
3	0.125	11	0.459	19	0.792
4	0.167	12	0.500	20	0.833
5	0.208	13	0.542	21	0.875
6	0.250	14	0.583	22	0.917
7	0.292	15	0.625	23	0.958
8	0.333	16	0.666	24	1.000

DECIMAL EQUIVALENTS TO FRACTIONAL PARTS OF LINEAL MEASURES.

One Inch the Integer or whole Number.

Inch.	Dec.	Inch.	Dec.	Inch.	Dec.
7/8 + 3-32 =	.96875	5/8 + 1-32 =	.65625	1/4 + 3-32 =	.34375
7/8 " 1-16 "	.9375	5/8 " "	.625	1/4 " 1-16 "	.3125
7/8 " 1-32 "	.90625	1/2 " 3-32 "	.59375	1/4 " 1-32 "	.28124
7/8 " "	.875	1/2 " 1-16 "	.5625	1/4 " "	.25
3/4 " 3-32 "	.84375	1/2 " 1-32 "	.53125	1/8 " 3-32 "	.21875
3/8 " 1-16 "	.8125	1/2 " "	.5	1/8 " 1-16 "	.1875
3/4 " 1-32 "	.78125	3/8 " 3-32 "	.46875	1/8 " 1-32 "	.15625
3/4 " "	.75	3/8 " 1-16 "	.4375	1/8 " "	.125
5/8 " 3-32 =	.71875	3/8 " 1-32 "	.40625	3-32 "	.09375
5/8 " 1-16 "	.6875	3/8 " "	.375	1-16 "	.0625

ONE FOOT OF 12 INCHES.

Inch.	Dec.	Inch.	Dec.	Inch.	Dec.	Inch.	Dec.
11 =	.9166	6 =	.5	1 =	.0833	3/8 =	.03125
10 "	.6338	5 "	.4166	7/8 "	.07291	1/4 "	.02083
9 "	.75	4 "	.3333	3/4 "	.0625	1/8 "	.01041
8 "	.6666	3 "	.25	5/8 "	.05208		
7 "	.5833	2 "	.1666	1/2 "	.04166		

SAW-LOGS REDUCED TO INCH BOARD MEASURE.

Length in Feet.	DIAMETER IN INCHES.													
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
10	49	61	72	89	99	116	133	150	175	190	209	235	242	287	313
11	54	67	79	93	109	127	147	165	192	209	230	259	278	315	344
12	59	73	86	107	119	139	160	180	210	228	251	283	303	344	375
13	64	79	93	116	129	150	173	195	227	247	272	306	328	373	403
14	69	85	100	125	139	162	187	210	245	266	292	330	353	401	439
15	74	91	107	134	149	173	200	225	262	285	313	353	379	430	469
16	79	97	114	142	159	185	213	240	280	304	334	377	404	459	500
17	84	103	122	151	168	196	227	255	297	323	355	400	429	487	531
18	89	109	129	160	178	208	240	270	315	342	376	424	454	516	562
19	93	116	136	169	188	219	253	285	332	361	397	447	480	545	594
20	98	122	143	178	198	232	267	300	350	380	418	470	505	573	625
21	103	128	150	187	208	243	280	315	368	399	439	495	530	603	656
22	108	134	157	196	218	255	293	330	385	418	460	518	555	631	688
23	113	140	164	205	228	266	307	345	403	437	480	542	571	659	719
24	118	146	172	214	238	278	320	360	420	456	501	566	606	688	750
25	123	152	179	223	248	289	333	375	438	475	522	589	631	717	781

Length in Feet	DIAMETER IN INCHES.											
	27	28	29	30	31	32	33	34	35	36	37	38
10	342	363	381	411	444	460	490	500	547	577	644	669
11	377	400	419	457	488	506	539	550	602	634	708	734
12	411	436	457	493	532	552	588	600	657	692	772	801
13	445	473	495	534	576	598	637	650	712	750	836	868
14	479	509	533	575	622	644	686	700	766	807	901	934
15	514	545	571	616	666	690	735	750	821	865	965	1001
16	548	582	609	657	710	736	784	800	876	923	1029	1068
17	582	618	647	698	755	782	833	850	931	980	1094	1134
18	616	654	685	739	799	828	882	900	985	1038	1158	1201
19	650	692	723	780	843	874	931	950	1040	1096	1222	1268
20	684	728	761	821	888	920	980	1000	1095	1152	1287	1335
21	719	764	800	863	932	966	1029	1050	1150	1210		
22	753	800	838	904	976	1012	1078	1100	1204	1268		
23	787	837	876	945	1021	1058	1127	1150	1259	1322		
24	821	873	914	986	1065	1104	1176	1200	1314	1380		
25	856	910	952	1027	1109	1150	1225	1250	1369	1438		

To find the amount of lumber any log will make—First, find the length of the log in the first or left-hand column; then, on the top of the page, to the right, find the diameter and under the same will be found the quantity of lumber your log will make; calculated for any length from 10 to 25 feet, and for any diameter from 12 to 38 inches.

Table to Facilitate the Mensuration of Timber, Flat or Board Measure.

Breadth in Ins.	Area of a lin. ft.	Breadth in Ins.	Area of a lin. ft.	Breadth in Ins.	Area of a lin. ft.	Breadth in Ins.	Area of a lin. ft.
1/4	.0208	31/4	.2708	61/4	.5208	91/4	.7708
1/2	.0417	31/2	.2916	61/2	.5416	91/2	.7917
3/4	.0625	33/4	.3125	63/4	.5625	93/4	.8125
1	.0834	4	.3334	7	.5833	10	.8334
11/4	.1042	41/4	.3542	71/4	.6042	101/4	.8542
11/2	.1250	41/2	.3750	71/2	.6250	101/2	.8750
13/4	.1459	43/4	.3958	73/4	.6458	103/4	.8959
2	.1667	5	.4167	8	.6667	11	.9167
21/4	.1875	51/4	.4375	81/4	.6875	111/4	.9375
21/2	.2084	51/2	.4583	81/2	.7084	111/2	.9583
23/4	.2292	53/4	.4792	83/4	.7292	113/4	.9792
3	.2500	6	.5000	9	.7500		

RULE.—Multiply the length by the number in the table corresponding to any given number.

EXAMPLE.—Given a board 16½ feet in length and 9¾ inches in breadth.

The number in the table opposite 9¾ inches = .8125 × 16½ = 13.4 square feet.

Contents (Board Measure) of 1 lineal foot of Timber.

Br'th in Ins	THICKNESS IN INCHES.											
	2	3	4	5	6	7	8	9	10	11	12	13
18	3.	4.5	6.	7.5	9.	10.5	12.	13. 5	15.	16. 5	18.	19.5
17	2.83	4.25	5.66	7.08	8.5	9.92	11.32	12.75	14.17	15.58	17.	18.42
16	2.67	4.	5.33	6.67	8.	9.33	10.67	12.	13.33	14.67	16.	17.33
15	2.50	3.75	5.	6.25	7.5	8.75	10.00	11.25	12.5	13.75	15.	16.25
14	2.33	3.5	4.67	5.83	7.	8.17	9.33	10.5	11.67	12.83	14.	15.17
13	2.17	3.25	4.33	5.42	6.5	7.58	8.67	9.75	10.83	11.92	13.	14.08
12	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	
11	1.83	2.75	3.67	4.58	5.5	6.42	7.33	8.25	9.17	10.08		
10	1.67	2.5	3.33	4.17	5.	5.83	6.67	7.5	8.33			
9	1.5	2.25	3.	3.75	4.5	5.25	6.	6.75				
8	1.33	2.	2.67	3.33	4.	4.67	5.33					
7	1.17	1.75	2.33	3.92	3.5	4.08						
6	1.	1.5	2.	2.50	3.							
5	.83	1.25	1.67	2.08								
4	.67	1.	1.33									
3	.50	.75										
2	.33											

To ascertain the contents of a piece of timber. Find in the table the contents of one foot and multiply by the length in feet of piece.

EXAMPLE:—What is the contents of a piece of timber 10 × 11. 20 feet long? 9.17 × 20 = 183.4 feet. B. M.

TABLE TO FACILITATE THE MENSURATION OF THE SOLIDITY OF TIMBER.

1 qr girth in inches.	Area in Feet.	1 qr girth in Inches.	Area in Feet,	1 qr girth in Inches.	Area in Feet.
6	.250	12¼	1.042	19	2.506
6¼	.272	12½	1.085	19½	2.640
6½	.294	12¾	1.129	20	2.777
6¾	.317	13	1.174	20½	2.917
7	.340	13¼	1.219	21	3.062
7¼	.364	13½	1.265	21½	3.209
7½	.390	13¾	1.313	22	3 362
7¾	.417	14	1.361	22½	3.516
8	.444	14¼	1.410	23	3.673
8¼	.472	14½	1.460	23½	3.835
8½	.501	14¾	1.511	24	4.000
8¾	.531	15	1.562	24½	4.168
9	.562	15¼	1.615	25	4.340
9¼	.594	15½	1.668	25½	4.516
9½	.626	15¾	1.722	26	4.694
9¾	.659	16	1.777	26½	4.876
10	.694	16¼	1.833	27	5.062
10¼	.730	16½	1.890	27½	5.252
10½	.766	16¾	1.948	28	5.444
10¾	.803	17	2.006	28½	5.640
11	.840	17¼	2.066	29	5.840
11¼	.878	17½	2.126	29½	6,044
11½	.918	17¾	2.187	30	6.250
11¾	.959	18	2.250		
12	1.000	18½	2.376		

RULE:—Multiply the area corresponding to the quarter girth in inches by the length in feet.

EXAMPLE:—Given a piece of timber 20 feet long and 12 inches square.

The number opposite 12 inches $= 1.000 \times 20 = 20$ Cubic feet.

The following table of scantling measure gives the number of feet in a scantling from 1 foot to 13 feet and from 2×2 to 11×12.

EXAMPLE:—How many feet in a 5×6 scantling 10 feet long? First find 10 feet under the column marked "Length in Feet" and opposite the number under the column marked 5×6 will be found 25 feet, the number of feet, the scantling contains,

If your scantling is longer than that given in the table take two lengths and add them together.

EXAMPLE:—How many feet in a 3×4 scantling 21 feet long? Opposite 10 feet and under 3×4 is 10 feet. Opposite 11 feet and under 3×4 is 11 feet. Then $10 + 11 = 21$ feet, the number of feet the scantling contains.

SCANTLING MEASURE.

Length in Feet.	INCHES.											
	2×2		2×3		2×4		2×5		2×6		2×7	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
1	0	4	0	6	0	8	0	10	1	0	1	2
2	0	8	1	0	1	4	1	8	2	0	2	4
3	1	0	1	6	2	0	2	6	3	0	3	6
4	1	4	2	0	2	8	3	4	4	0	4	8
5	1	8	2	6	3	4	4	2	5	0	5	10
6	2	0	3	0	4	0	5	0	6	0	7	0
7	2	4	3	6	4	8	5	10	7	0	8	2
8	2	8	4	0	5	4	6	8	8	0	9	4
9	3	0	4	6	6	0	7	6	9	0	10	6
10	3	4	5	0	6	8	8	4	10	0	11	8
11	3	8	5	6	7	4	9	2	11	0	12	10
12	4	0	6	0	8	0	10	0	12	0	14	0
13	4	4	6	6	8	8	10	10	13	0	15	2
	2½×3		2½×4		2½×5		2½×6		2½×7		2½×8	
1	0	8	0	10	1	1	1	3	1	6	1	8
2	1	3	1	8	2	1	2	6	2	11	3	4
3	1	11	2	6	3	1	3	9	4	5	5	0
4	2	6	3	4	4	2	5	0	5	10	6	8
5	3	2	4	2	5	3	6	3	7	4	8	4
6	3	9	5	0	6	3	7	6	8	9	10	0
7	4	5	5	10	7	4	8	9	10	3	11	8
8	5	0	6	8	8	4	10	0	11	8	13	4
9	5	8	7	6	9	5	11	3	13	2	15	0
10	6	3	8	4	10	5	12	6	14	7	16	8
11	6	11	9	2	11	6	13	9	16	1	18	4
12	7	6	10	0	12	6	15	0	17	6	20	0
13	8	2	10	10	13	7	16	3	19	0	21	8
	3×3		3×4		3×5		3×6		3×7		3×8	
1	0	9	1	0	1	3	1	6	1	9	2	0
2	1	6	2	0	2	6	3	0	3	6	4	0
3	2	3	3	0	3	9	4	6	5	3	6	0
4	3	0	4	0	5	0	6	0	7	0	8	0
5	3	9	5	0	6	3	7	6	8	9	10	0
6	4	6	6	0	7	6	9	0	10	6	12	0
7	5	3	7	0	8	9	10	6	12	3	14	0
8	6	0	8	0	10	0	12	0	14	0	16	0
9	6	9	9	0	11	3	13	6	15	9	18	0
10	7	6	10	0	12	6	15	0	17	6	20	0
11	8	3	11	0	13	9	16	6	19	3	22	0
12	9	0	12	0	15	0	18	0	21	0	24	0
13	9	9	13	0	16	3	19	6	22	9	26	0

SCANTLING MEASURE.

Length in Feet.	INCHES.											
	4×4		4×5		4×6		4×7		4×8		4×9	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
1	1	4	1	8	2	0	2	4	2	8	3	0
2	2	8	3	4	4	0	4	8	5	4	6	0
3	4	0	5	0	6	0	7	0	8	0	9	0
4	5	4	6	8	8	0	9	4	10	8	12	0
5	6	8	8	4	10	0	11	8	13	4	15	0
6	8	0	10	0	12	0	14	0	16	0	18	0
7	9	4	11	8	14	0	16	4	18	8	21	0
8	10	8	13	4	16	0	18	8	21	4	24	0
9	12	0	15	0	18	0	21	0	24	0	27	0
10	13	4	16	8	20	0	23	4	26	8	30	0
11	14	8	18	4	22	0	25	8	29	4	33	0
12	16	0	20	0	24	0	28	0	32	0	36	0
13	17	4	21	8	26	0	30	4	34	8	39	0

	5×5		5×6		5×7		5×8		5×9		5×10	
1	2	1	2	6	2	11	3	4	3	9	4	2
2	4	2	5	0	5	10	6	8	7	6	8	4
3	6	3	7	6	8	9	10	0	11	3	12	6
4	8	4	10	0	11	8	13	4	15	0	16	8
5	10	5	12	6	14	7	16	8	18	9	20	10
6	12	6	15	0	17	6	20	0	22	6	25	0
7	14	7	17	6	20	5	23	4	26	3	29	2
8	16	8	20	0	23	4	26	8	30	0	33	4
9	18	9	22	6	26	3	30	0	33	9	37	6
10	20	10	25	0	29	2	33	4	37	6	41	8
11	22	11	27	6	32	1	36	8	41	3	45	10
12	25	0	30	0	35	0	40	0	45	0	50	0
13	27	1	32	6	37	11	43	4	48	9	54	2

	6×6		6×7		6×8		6×9		6×10		6×11	
1	3	0	3	6	4	0	4	6	5	0	5	6
2	6	0	7	0	8	0	9	0	10	0	11	0
3	9	0	10	6	12	0	13	6	15	0	16	6
4	12	0	14	0	16	0	18	0	20	0	22	0
5	15	0	17	6	20	0	22	6	25	0	27	6
6	18	0	21	0	24	0	27	0	30	0	33	0
7	21	0	24	6	28	0	31	6	35	0	38	6
8	24	0	28	0	32	0	36	0	40	0	44	0
9	27	0	31	6	36	0	40	6	45	0	49	6
10	30	0	35	0	40	0	45	0	50	0	55	0
11	33	0	38	6	44	0	49	6	55	0	60	6
12	36	0	42	0	48	0	54	0	60	0	66	0
13	39	0	45	6	52	0	58	6	65	0	71	6

SCANTLING MEASURE.

Length in Feet.	INCHES.											
	7×7		7×8		7×9		7×10		7×11		7×12	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
1	4	1	4	8	5	3	5	10	6	5	7	0
2	8	2	9	4	10	6	11	8	12	10	14	0
3	12	3	14	0	15	9	17	6	19	3	21	0
4	16	4	18	8	21	0	23	4	25	8	28	0
5	20	5	23	4	26	3	29	2	32	1	35	0
6	24	6	28	0	31	6	35	0	38	6	42	0
7	28	7	32	8	36	9	40	10	44	11	49	0
8	32	8	37	4	42	0	46	8	51	4	56	0
9	36	9	42	0	47	3	52	6	57	9	63	0
10	40	10	46	8	52	6	58	4	64	2	70	0
11	44	11	51	4	57	9	64	2	70	7	77	0
12	49	0	56	0	63	0	70	0	77	0	84	0
13	53	1	60	8	68	3	75	10	83	5	91	0
	8×8		8×9		8×10		8×11		8×12		9×9	
1	5	4	6	0	6	8	7	4	8	0	6	9
2	10	8	12	0	13	4	14	8	16	0	13	6
3	16	0	18	0	20	0	22	0	24	0	20	3
4	21	4	24	0	26	8	29	4	32	0	27	0
5	26	8	30	0	33	4	36	8	40	0	33	9
6	32	0	36	0	40	0	44	0	48	0	40	6
7	37	4	42	0	46	8	51	4	56	0	47	3
8	42	8	48	0	53	4	58	8	64	0	54	0
9	48	0	54	0	60	0	66	0	72	0	60	9
10	53	4	60	0	66	8	73	4	80	0	67	6
11	58	8	66	0	73	4	80	8	88	0	74	3
12	64	0	72	0	80	0	88	0	96	0	81	0
13	69	4	78	0	86	8	95	4	104	0	87	9
	9×10		9×11		9×12		10×10		10×11		10×12	
1	7	6	8	3	9	0	8	4	9	2	10	0
2	15	0	16	6	18	0	16	8	18	4	20	0
3	22	6	24	9	27	0	25	0	27	6	30	0
4	30	0	33	0	36	0	33	4	36	8	40	0
5	37	6	41	3	45	0	41	8	45	10	50	0
6	45	0	49	6	54	0	50	0	55	0	60	0
7	52	6	57	9	63	0	58	4	64	2	70	0
8	60	0	66	0	72	0	66	8	73	4	80	0
9	67	6	74	3	81	0	75	0	82	6	90	0
10	75	0	82	6	90	0	83	4	91	8	100	0
11	82	6	90	9	99	0	91	8	100	10	110	0
12	90	0	99	0	108	0	100	0	110	0	120	0
13	97	6	107	3	117	0	108	4	119	2	130	0

BOARD MEASURE, (1 inch thick).

Length in Feet.	WIDTH IN INCHES.											
	4		5		6		7		8		9	
	ft.	in	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
1	0	4	0	5	0	6	0	7	0	8	0	9
2	0	8	0	10	1	0	1	2	1	4	1	6
3	1	0	1	3	1	6	1	9	2	0	2	3
4	1	4	1	8	2	0	2	4	2	8	3	0
5	1	8	2	1	2	6	2	11	3	4	3	9
6	2	0	2	6	3	0	3	6	4	0	4	6
7	2	4	2	11	3	6	4	1	4	8	5	3
8	2	8	3	4	4	0	4	8	5	4	6	0
9	3	0	3	9	4	6	5	3	6	0	6	9
10	3	4	4	2	5	0	5	10	6	8	7	6
11	3	8	4	7	5	6	6	5	7	4	8	3
12	4	0	5	0	6	0	7	0	8	0	9	0
13	4	4	5	5	6	6	7	7	8	8	9	9
	10		11		12		13		14		15	
1	0	10	0	11	1		1	1	1	2	1	3
2	1	8	1	10	2		2	2	2	4	2	6
3	2	6	2	9	3		3	3	3	6	3	9
4	3	4	3	8	4		4	4	4	8	5	0
5	4	2	4	7	5		5	5	5	10	6	3
6	5	0	5	6	6		6	6	6	0	7	6
7	5	10	6	5	7		7	7	7	2	8	9
8	6	8	7	4	8		8	8	8	4	10	0
9	7	6	8	3	9		9	9	9	6	11	3
10	8	4	9	2	10		10	10	10	8	12	6
11	9	2	10	1	11		11	11	11	10	13	9
12	10	0	11	0	12		13	0	14	0	15	0
13	10	10	11	11	13		14	1	15	2	16	3
	16		17		18		19		20		21	
1	1	4	1	5	1	6	1	7	1	8	1	9
2	2	8	2	10	3	0	3	2	3	4	3	6
3	4	0	4	3	4	6	4	9	5	0	5	3
4	5	4	5	8	6	0	6	4	6	8	7	0
5	6	8	7	1	7	6	7	11	8	4	8	9
6	8	0	8	6	9	0	9	6	10	0	10	6
7	9	4	9	11	10	6	11	1	11	8	12	3
8	10	8	11	4	12	0	12	8	13	4	14	0
9	12	0	12	9	13	6	14	3	15	0	15	9
10	13	4	14	2	15	0	15	10	16	8	17	6
11	14	8	15	7	16	6	17	5	18	4	19	3
12	16	0	17	0	18	0	19	0	20	0	21	0
13	17	4	18	5	19	6	20	7	21	8	22	9

NOTE:—The rule for this table is worked in the same manner as the rule for scantling measure, on page 151.

BOARD MEASURE, (2 inch thick).

Length in Feet.	WIDTH IN INCHES.											
	6		7		8		9		10		11	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
8	8		9	4	10	8	12	0	13	4	14	8
9	9		10	6	12	0	13	6	15	0	16	6
10	10		11	8	13	4	15	0	16	8	18	4
11	11		12	10	14	8	16	6	18	4	20	2
12	12		14	0	16	0	18	0	20	0	22	0
13	13		15	2	17	4	19	6	21	8	23	10
14	14		16	4	18	8	21	0	23	4	25	8
15	15		17	6	20	0	22	6	25	0	27	6
16	16		18	8	21	4	24	0	26	8	29	4
17	17		19	10	22	8	25	6	28	4	31	2
18	18		21	0	24	0	27	0	30	0	33	0
19	19		22	2	25	4	28	6	31	8	34	10
20	20		23	4	26	8	30	0	33	4	36	8
	12		13		14		15		16		17	
8	16		17	4	18	8	20	0	21	4	22	8
9	18		19	6	21	0	22	6	24	0	25	6
10	20		21	8	23	4	25	0	26	8	28	4
11	22		23	10	25	8	27	6	29	4	31	2
12	24		26	0	28	0	30	0	32	0	34	0
13	26		28	2	30	4	32	6	34	8	36	10
14	28		30	4	32	8	35	0	37	4	39	8
15	30		32	6	35	0	37	6	40	0	42	6
16	32		34	8	37	4	40	0	42	8	45	4
17	34		36	10	39	8	42	6	45	4	48	2
18	36		39	0	42	0	45	0	48	0	51	0
19	38		41	2	44	4	47	6	50	8	53	10
20	40		43	4	46	8	50	0	53	4	56	8
	18		19		20		21		22		23	
8	24		25	4	26	8	28	0	29	4	30	8
9	27		28	6	30	0	31	6	33	0	34	6
10	30		31	8	33	4	35	0	36	8	38	4
11	33		34	10	36	8	38	6	40	4	42	2
12	36		38	0	40	0	42	0	44	0	46	0
13	39		41	2	43	4	45	6	47	8	49	10
14	42		44	4	46	8	49	0	51	4	53	8
15	45		47	6	50	0	52	6	55	0	57	6
16	48		50	8	53	4	56	0	58	8	61	4
17	51		53	10	56	8	59	6	62	4	65	2
18	54		57	0	60	0	63	0	66	0	69	0
19	57		60	2	63	4	66	6	69	8	72	10
20	60		63	4	66	8	70	0	73	4	76	8

NOTE:—The rule for this table is worked in the same manner as the rule for scantling measure, on page 151.

Cubic Contents of Square Timber.

Length in Feet.	INCHES.											
	6×6		6×7		6×8		6×9		6×10		6×11	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
10	2	6	2	11	3	4	3	9	4	2	4	7
11	2	9	3	3	3	8	4	2	4	7	5	1
12	3	0	3	6	4	0	4	6	5	0	5	6
13	3	3	3	10	4	4	4	11	5	5	6	0
14	3	6	4	1	4	8	5	3	5	10	6	5
15	3	9	4	5	5	0	5	8	6	3	6	11
16	4	0	4	8	5	4	6	0	6	8	7	4
17	4	3	5	0	5	8	6	5	7	1	7	10
18	4	6	5	3	6	0	6	9	7	6	8	3
19	4	9	5	7	6	4	7	2	7	11	8	9
20	5	0	5	10	6	8	7	8	8	4	9	2
21	5	3	6	2	7	0	7	11	8	9	9	8
22	5	6	6	5	7	4	8	3	9	2	10	1
	7×7		7×8		7×9		7×10		7×11		7×12	
10	3	5	3	11	4	5	4	10	5	4	5	10
11	3	9	4	3	4	10	5	4	5	11	6	5
12	4	1	4	8	5	3	5	10	6	5	7	0
13	4	5	5	1	5	8	6	4	6	11	7	7
14	4	9	5	5	6	2	6	10	7	6	8	2
15	5	1	5	8	6	7	7	4	8	0	8	9
16	5	5	6	3	7	0	7	9	8	7	9	4
17	5	9	6	7	7	5	8	3	9	1	9	11
18	6	2	7	0	7	11	8	9	9	8	10	6
19	6	6	7	5	8	4	9	3	10	2	11	1
20	6	10	7	9	8	9	9	9	10	8	11	8
21	7	2	8	2	9	2	10	3	11	3	12	3
22	7	6	8	7	9	8	10	8	11	9	12	10
	8×8		8×9		8×10		8×11		8×12		8×13	
10	4	5	5	0	5	7	6	1	6	8	7	3
11	4	11	5	6	6	1	6	9	7	4	7	11
12	5	4	6	0	6	8	7	4	8	0	8	8
13	5	9	6	6	7	3	7	11	8	8	9	5
14	6	3	7	0	7	9	8	7	9	4	10	1
15	6	8	7	6	8	4	9	2	10	0	10	10
16	7	1	8	0	8	11	9	9	10	8	11	7
17	7	7	8	6	9	5	10	5	11	4	12	3
18	8	0	9	0	10	0	11	0	12	0	13	0
19	8	5	9	6	10	7	11	7	12	8	13	9
20	8	11	10	0	11	1	12	3	13	4	14	5
21	9	4	10	6	11	8	12	10	14	0	15	2
22	9	9	11	0	12	3	13	5	14	8	15	11

NOTE:—The rule for this table is worked in the same manner as the rule for scantling measure, on page 151.

Cubic Contents of Round Timber.

Length in Feet.	DIAMETER IN INCHES.											
	10		11		12		13		14		15	
	ft.	in	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
13	7	1	8	7	10	3	12	0	13	11	15	11
14	7	8	9	3	11	0	12	11	15		17	2
15	8	2	9	11	11	9	13	10	16	1	18	5
16	8	9	10	7	12	7	14	9	17	1	19	8
17	9	3	11	3	13	4	15	8	18	2	20	10
18	9	10	11	11	14	2	16	7	19	3	22	1
19	10	4	12	7	14	11	17	6	20	4	23	4
20	10	11	13	2	15	9	18	5	21	5	24	7
21	11	6	13	10	16	6	19	4	22	6	25	9
22	12	0	14	6	17	3	20	3	23	6	27	0
23	12	7	15	2	18	1	21	3	24	7	28	3
24	13	1	15	10	18	10	22	2	25	8	29	6
25	13	8	16	6	19	8	23	1	26	9	30	8
	16		17		18		19		20		21	
13	18	2	20	6	23	0	25	7	28	4	31	3
14	19	7	22	1	24	9	27	7	30	7	33	8
15	20	11	23	8	26	6	29	7	32	9	36	1
16	22	4	25	3	28	3	31	6	34	11	38	6
17	23	9	26	10	30	1	33	6	37	1	40	11
18	25	2	28	5	31	10	35	5	39	3	43	4
19	26	6	30	0	33	7	37	5	41	6	45	9
20	27	11	31	6	35	4	39	5	43	8	48	2
21	29	4	33	1	37	2	41	4	45	10	50	6
22	30	9	34	8	38	11	43	4	48	0	52	11
23	32	2	36	3	40	8	45	4	50	2	55	4
24	33	6	37	10	42	5	47	3	52	5	57	9
25	34	11	39	5	44	2	49	3	54	7	60	2
	22		23		24		25		26		27	
13	34	4	37	6	40	10	44	4	47	11	51	9
14	37	0	40	5	44	0	47	9	51	8	55	8
15	39	7	43	4	47	2	51	2	55	4	59	8
16	42	3	46	2	50	3	54	7	59	0	63	8
17	44	11	49	1	53	5	58	0	62	8	67	7
18	47	6	51	11	56	7	61	5	66	5	71	7
19	50	2	54	10	59	9	64	10	70	1	75	7
20	52	10	57	9	62	10	68	2	73	9	79	7
21	55	6	60	7	66	0	71	7	77	6	83	6
22	58	1	63	6	69	2	75	0	81	2	87	6
23	60	9	66	5	72	3	78	5	84	10	91	6
24	63	5	69	3	75	5	81	10	88	6	95	6
25	66	0	72	2	78	7	85	3	92	3	99	5

Note:—The rule for this table is worked in the same manner as the rule for scantling measure, on page 151.

Cubic Contents of Round Timber when Squared.

Length in Feet.	DIAMETER IN INCHES.											
	10		11		12		13		14		15	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
13	4	1	4	11	5	10	6	10	8	0	9	2
14	4	5	5	4	6	4	7	5	8	7	9	10
15	4	8	5	8	6	9	7	11	9	2	10	7
16	5	0	6	1	7	2	8	5	9	10	11	3
17	5	4	6	5	7	8	9	0	10	5	11	11
18	5	8	6	10	8	1	9	6	11	0	12	8
19	5	11	7	2	8	7	10	0	11	8	13	4
20	6	3	7	7	9	0	10	7	12	3	14	1
21	6	7	7	11	9	5	11	1	12	10	14	9
22	6	11	8	4	9	11	11	7	13	6	15	6
23	7	2	8	8	10	4	12	2	14	1	16	2
24	7	6	9	1	10	10	12	8	14	8	16	11
25	7	10	9	5	11	3	13	2	15	4	17	7
	16		17		18		19		20		21	
13	10	5	11	9	13	2	14	8	16	3	17	11
14	11	2	12	8	14	2	15	10	17	6	19	4
15	12	0	13	7	15	2	16	11	18	9	20	8
16	12	9	14	5	16	2	18	1	20	0	22	1
17	13	7	15	4	17	3	19	2	21	3	23	5
18	14	5	16	3	18	3	20	4	22	6	24	10
19	15	2	17	2	19	3	21	5	23	9	26	2
20	16	0	18	1	20	3	22	7	25	0	27	7
21	16	9	19	0	21	3	23	8	26	3	28	11
22	17	7	19	10	22	3	24	10	27	6	30	4
23	18	5	20	9	23	3	25	11	28	9	31	8
24	19	2	21	8	24	4	27	1	30	0	33	1
25	20	0	22	7	25	4	28	2	31	3	34	5
	22		23		24		25		26		27	
13	19	8	21	6	23	5	25	5	27	6	29	7
14	21	2	23	2	25	2	27	4	29	7	31	11
15	22	8	24	10	27	0	29	4	31	8	34	2
16	24	2	26	5	28	10	31	3	33	10	36	5
17	25	9	28	1	30	7	33	2	35	11	38	9
18	27	3	29	9	32	5	35	2	38	0	41	0
19	28	9	31	5	34	2	37	1	40	2	43	3
20	30	3	33	1	36	0	39	1	42	3	45	7
21	31	9	34	9	37	10	41	0	44	4	47	10
22	33	3	36	4	39	7	43	0	46	6	50	1
23	34	9	38	0	41	5	44	11	48	7	52	5
24	36	4	39	8	43	2	46	11	50	8	54	8
25	37	10	41	4	45	0	48	10	52	10	56	11

Note:—The rule for this table is worked in the same manner as the rule for scantling measure, on page 151.

STANDARD CONTENTS OF LOGS.

Length in Feet.	DIAMETER IN INCHES.					
	10	11	12	13	14	15
10	.21	.26	.31	.36	.42	.48
11	.23	.28	.34	.40	.46	.53
12	.26	.31	.37	.43	.50	.58
13	.28	.34	.40	.47	.54	.62
14	.30	.36	.43	.50	.58	.67
15	.32	.39	.46	.54	.63	.72
16	.34	.41	.49	.58	.67	.77
17	.36	.44	.52	.61	.71	.81
18	.38	.46	.55	.64	.75	.86
19	.40	.49	.58	.68	.79	.91
20	.43	.52	.61	.72	.84	.96
21	.45	.54	.64	.76	.88	1.01
22	.47	.57	.67	.79	.92	1.05
	16	17	18	19	20	21
10	.55	.62	.69	.77	.85	.94
11	.60	.68	.76	.85	.94	1.03
12	.65	.74	.83	.92	1.02	1.13
13	.71	.80	.90	1.00	1.11	1.22
14	.76	.86	.97	1.08	1.19	1.32
15	.82	.92	1.04	1.15	1.28	1.41
16	.87	.99	1.10	1.23	1.36	1.50
17	.93	1.05	1.17	1.31	1.45	1.60
18	.98	1.11	1.24	1.38	1.53	1.69
19	1.04	1.17	1.31	1.46	1.62	1.79
20	1.09	1.23	1.38	1.54	1.70	1.88
21	1.15	1.29	1.45	1.62	1.79	1.97
22	1.20	1.35	1.52	1.69	1.88	2.07
	22	23	24	25	26	27
10	1.03	1.13	1.23	1.33	1.44	1.55
11	1.13	1.24	1.35	1.46	1.58	1.71
12	1.24	1.35	1.47	1.60	1.73	1.86
13	1.34	1.47	1.60	1.73	1.86	2.02
14	1.44	1.58	1.72	1.86	2.02	2.17
15	1.55	1.69	1.84	2.00	2.16	2.33
16	1.65	1.80	1.96	2.13	2.30	2.49
17	1.75	1.92	2 09	2.26	2.45	2.64
18	1.86	2.03	2.21	2.40	2.59	2.80
19	1.96	2.14	2.33	2.53	2.74	2.95
20	2.06	2.25	2.46	2.66	2.88	3.11
21	2.17	2.37	2.58	2.80	3.02	3.26
22	2.27	2.48	2.70	2.93	3.17	3.42

NOTE:—A log 13 feet long and 19 inches in diameter is the standard. The table shows the comparison of logs with this standard.

Table showing the Temperature of Steam at different pressures, from 1 lb., to 240 lbs., per square inch, and the quantity of Steam produced from a cubic inch of water, according to pressure.

Pressure per Sq. In.	Corresp'd'g Temp. of S. to pressure.	C. Ins. of S. from a C. In of water acc'd'g to P.	Pressure per Sq. In.	Corresp'd'g Temp. of S. to pressure.	C. Ins. of S. from a C.In of water acc'd'g to P.	Pressure per Sq. In.	Corresp'd'g Temp. of S. to pressure.	C. Ins. of S. from a C.In of water acc'd'g to P.
1	102.9	20868	39	267.5	695	77	313.1	374
2	126.1	10874	40	269.1	679	78	314.0	370
3	141.0	7437	41	270.6	666	79	314.9	366
4	152.3	5685	42	272.1	649	80	315.8	362
5	161.4	4617	43	273.6	635	81	316.7	358
6	169.2	3897	44	275.0	622	82	317.6	354
7	175.9	3376	45	276.4	610	83	318.4	350
8	182.0	2983	46	277.8	589	84	319.3	346
9	187.4	2674	47	279.2	586	85	320.1	342
10	192.4	2426	48	280.5	575	86	321.0	339
11	197.0	2221	49	281.9	564	87	321.8	335
12	201.3	2050	50	283.2	554	88	322.6	332
13	205.3	1904	51	284.4	544	89	323.5	328
14	209.1	1778	52	285.7	534	90	324.3	325
15	212.8	1669	53	286.9	525	91	325.1	322
16	216.3	1573	54	288.1	516	92	325.9	319
17	219.6	1488	55	289.3	508	93	326.7	316
18	222.7	1411	56	290.5	500	94	327.5	313
19	225.6	1343	57	291.7	492	95	328.2	310
20	228.5	1281	58	292.9	484	96	329.0	307
21	231.2	1225	59	294.2	477	97	329.8	304
22	233.8	1174	60	295.6	470	98	330.5	301
23	236.3	1127	61	296.9	463	99	331.3	298
24	238.7	1084	62	298.1	456	100	332.0	295
25	241.0	1044	63	299.2	449	110	339.2	271
26	243.3	1007	64	300.3	443	120	345.8	251
27	245.5	973	65	301.3	437	130	352.1	233
28	247.6	941	66	302.4	431	140	357.9	218
29	249.6	911	67	303.4	425	150	363.4	205
30	251.6	883	68	304.4	419	160	368.7	193
31	253.6	857	69	305.4	414	170	373.6	183
32	255.5	833	70	306.4	408	180	378.4	174
33	257.3	810	71	307.4	403	190	382.9	166
34	259.1	788	72	308.4	398	200	387.3	158
35	260.9	767	73	309.3	393	210	391.5	151
36	262.6	748	74	310.3	388	220	395.5	145
37	264.3	729	75	311.2	383	230	399.4	140
38	265.9	712	76	312.2	379	240	403.1	134

NOTE:—Add the pressure of the atmosphere 15 lbs to the pressure on the Steam gauge, to correspond with the table.

Table showing the average Pressure of the Steam upon the Piston throughout the Stroke when cut-off in the Cylinder, from 1-3 to 11-12 commencing with 10 lbs., and advancing in 5 lbs., up to 135 lbs., Pressure.

Steam Cut-off in the Cylinder.	Pressure in lbs., at the Commencement of the Stroke.													
	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	Average Pressure in lbs. upon the Piston.													
1/3	7	10 1/3	14 1/2	17 1/2	21	24 1/2	28	31 1/2	35	38 1/3	42	45 1/2	49	52 1/2
2/3	9 1/4	14	18 2/3	23 1/2	28 1/4	32 3/4	37 1/4	42	46 3/4	51 1/3	56 1/4	61	65 1/3	70 1/4
1/4	6	9	12	15	17 3/4	20 3/4	23 3/4	26 3/4	29 3/4	32 3/4	35 3/4	38 3/4	41 3/4	44 3/4
1/2	8 1/2	12 3/4	17	21	25 1/2	29 1/2	33 3/4	38	42 1/4	46 1/2	50 3/4	55	59 1/4	63 1/2
3/4	9 1/2	14 1/2	19 1/4	24	28 3/4	33 1/2	38 1/2	43 1/4	48 1/4	53	57 3/4	62 1/2	67 1/2	72 1/4
1-5	5 1/4	7 3/4	12 1/2	13	15 1/2	18 1/4	20 3/4	23 1/2	26	28 3/4	31 1/2	34	36 3/4	39
2-5	7 1/2	11 1/2	15 1/4	19	23	26 3/4	30 1/2	2 4 1/4	38 1/4	42	46	49 3/4	53 1/4	57 1/2
3-5	9	13	18	22 1/4	27	31 1/2	36 1/4	40 3/4	45 1/4	49 3/4	54 1/2	58 3/4	63 1/4	67 3/4
4-5	9 3/4	14 1/2	19 1/2	23 3/4	29	34 1/4	39	44	49	53 3/4	58 1/2	63 1/2	68 1/2	73 1/4
1-6	4 1/2	7	9 1/4	11 1/2	14	16 1/4	18 1/2	20 3/4	23 1/2	25 1/2	27 3/4	30 1/4	32 1/2	34 3/4
5-6	9 3/4	14 3/4	19 3/4	24 1/2	29 1/2	34 1/2	39 1/2	44 1/4	49 1/2	54	59	64	69	73 3/4
1-7	4 1/4	6 1/2	8 1/4	10 1/2	12 1/2	14 3/4	16 3/4	18 3/4	21	23 1/4	25 1/2	27 1/4	29 1/2	31 1/2
2-7	6 1/2	9 1/2	12 3/4	16	19 1/4	22 1/2	25 3/4	28 3/4	32	35 1/4	38 1/2	41 3/4	45	48 1/4
3-7	7 3/4	11 3/4	15 3/4	19 3/4	23 3/4	27 3/4	31 1/2	35 1/2	39 1/2	43 1/4	47 3/4	51 1/2	55 1/4	59 1/2
4-7	8 3/4	13 1/4	17 3/4	22 1/4	26 3/4	31 1/4	35 1/2	40	44 1/4	49	53 1/2	57 3/4	62 1/2	66 3/4
5-7	9 1/4	14 1/2	19	23 3/4	28 1/2	33 1/4	38 1/4	42 3/4	47 3/4	52 1/4	57 1/2	62	66 3/4	71 1/2
6-7	9 3/4	14 3/4	19 3/4	24 1/4	29 1/2	34 1/2	39 1/2	44 1/2	49 3/4	54 1/2	59 1/4	63 3/4	69 1/4	74 1/4
1/8	3 3/4	5 3/4	7 3/4	9 1/2	11 1/4	13 1/2	15 1/4	1 7 1/4	19 1/4	21 1/4	23	25	27	28 3/4
3/8	7 1/4	11	14 3/4	18 1/2	22 1/4	26	29 3/4	33 3/4	37	40 3/4	44 1/4	48 1/2	52	55 3/4
5/8	9 1/4	13 3/4	18 1/2	22 3/4	27 1/4	32	36 3/4	41 1/4	45 1/2	50 1/4	55 1/2	59 3/4	64 1/2	68 3/4
7/8	9 3/4	14 1/2	19 3/4	24 1/4	29 3/4	34 3/4	39 1/2	44 1/2	49 1/2	54 1/2	59 1/2	64 1/2	69 1/4	74 1/4
1-9	3 1/4	5 1/4	7	8 3/4	10 1/2	12 1/4	14 1/4	1 5 3/4	17 3/4	19 1/4	21 1/4	23	24 3/4	26 1/2
2-9	5 1/2	8 1/4	11	13 3/4	16 1/2	19 1/4	22 1/4	25	27 3/4	30 1/4	33 1/4	36	38 3/4	41 3/4
4-9	8	12	16	20	24	28	32	36	40 1/4	44 1/4	48 1/2	52 1/4	56 1/4	60 1/4
5-9	8 3/4	13 1/4	17 1/2	22	26 1/4	30 3/4	35 1/4	39 1/2	44	48 1/2	52 3/4	56 1/2	61 1/2	66
7-9	9 1/4	14 1/2	19 1/4	24 1/4	29	34	38 3/4	43 3/4	48 1/2	53 1/4	58 1/4	63 1/4	68	72 3/4
8-9	9 3/4	14 3/4	19 3/4	24 1/4	29 3/4	34 3/4	39 3/4	44 1/2	49 1/2	54 1/2	59 3/4	64 1/2	69 1/2	74 1/2
1-11	3	4 1/2	6	7 3/4	9 1/2	10 3/4	12 1/4	1 1 3/4	15 1/4	16 3/4	18 1/4	20	21 1/2	23
2-11	4 3/4	7 1/2	9 3/4	12 1/4	14 3/4	17 1/4	19 1/2	22	24 1/2	27	29 1/4	31 3/4	34 1/4	36 3/4
3-11	6 1/4	9 1/2	12 1/2	15 1/4	18 3/4	21 3/4	25	28	31 1/2	34 1/4	37 1/4	40 3/4	43 3/4	47
4-11	7 1/4	10 3/4	14 1/2	18 1/4	21 3/4	25 1/4	29 1/2	32 3/4	36 1/2	40 1/4	43 3/4	47 1/2	51	54 3/4
5-11	8	12	16 1/4	20 1/4	24 1/2	28 1/4	32 1/2	36 1/2	40 1/4	44 1/2	48 3/4	52 3/4	56 3/4	60 3/4
6-11	8 3/4	13	17 1/2	21 3/4	26 1/4	30 1/2	35	39 1/4	43 3/4	48	52 1/2	56 3/4	61 1/2	65 1/4
7-11	9 1/4	13 3/4	18 1/4	23	27 1/2	32 1/4	36 3/4	41 1/2	46	50 3/4	55 1/4	60	64 1/2	69 1/4
8-11	9 1/2	14 1/4	19	23 3/4	28 3/4	33 1/4	38 1/4	43	47 3/4	52 3/4	57 1/4	62 1/4	67	71 3/4
9-11	9 3/4	14 3/4	19 1/2	24 1/4	29 1/2	34 1/4	39 1/4	44	49	54	58 3/4	63 3/4	68 3/4	73 1/4
10-11	9 3/4	14 3/4	19 3/4	24 3/4	29 3/4	34 3/4	39 3/4	44 3/4	49 3/4	54 3/4	59 3/4	64 1/2	69 1/2	74 1/4
1-12	2 3/4	4 1/4	5 3/4	7 1/4	8 1/2	10	11 1/2	13	14 1/2	15 3/4	17 1/4	18 3/4	20 1/4	21 3/4
7-12	8 1/4	12 1/4	16 3/4	21	25 1/2	29 1/2	33 3/4	38	42 1/4	46 1/2	50 3/4	55	59 1/4	63 1/4
11-12	9 3/4	14 3/4	19 3/4	24 3/4	29 3/4	34 3/4	39 3/4	44 3/4	49 3/4	54 3/4	59 3/4	64 3/4	69 3/4	74 3/4

Table showing the average Pressure of the Steam upon the Piston throughout the Stroke when cut-off in the Cylinder, from 1-3 to 11-12 commencing with 10 lbs., and advancing in 5 lbs., up to 135 lbs., Pressure, (*Continued*).

Steam Cut-off in the Cylinder.	Pressure in lbs., at the Commencement of the Stroke.											
	80	85	90	95	100	105	110	115	120	125	130	135
	Average Pressure in lbs. upon the Piston.											
1/3	56	59½	63	66½	70	73	77½	80½	84	87½	91	94½
2/3	75	79½	84½	89	93¾	98½	103	107¾	112½	117	121¾	126½
1/4	47¾	50¾	53¾	56¾	59¾	62¾	65½	68½	71½	74½	77½	80½
1/2	67½	72	76½	80½	84½	89	93¼	97¼	101½	105½	110	114¼
3/4	77¼	82	87	91¾	96½	101¼	106¼	111	115¾	120¾	125½	130¼
1-5	41¾	44¼	47	49½	52¼	54¾	57¼	60	62½	65¼	67¾	70¼
2-5	61½	65	69	72¾	76½	80¼	84¼	88	91¾	95¾	99½	103¼
3-5	72½	77	81½	86	90¼	95½	99¼	104¼	108¾	113¼	117¾	122¼
4-5	78¾	83	88	92¾	97¾	102¾	107½	112½	117½	122¼	127¼	132
1-6	37¼	39½	41¾	44¼	46½	48¾	51¼	53½	55¾	58	60½	62¾
5-6	78¾	83¾	88¾	93¾	98½	103½	108¼	113¼	118¼	123¼	128	133
1-7	33¼	35¾	37¾	40	42	44	46	48¼	50½	52½	54¾	56¾
2-7	51½	54½	57¾	61	64¼	67½	70¾	74	77¼	80½	83½	86¾
3-7	63¼	67¼	71¼	75¼	79	83	87	91	95¾	98¾	102¾	106¾
4-7	71¼	65¾	80	84¾	89	93½	98	102½	106¾	111½	115¾	120¼
5-7	76½	81	85¾	90¾	95½	100½	105	109¾	114½	119½	124	128¾
6-7	79	84	89	93¾	98¾	103¾	108¾	113¾	118¾	123½	128½	133½
1/8	30¾	32¾	34½	36¾	38½	40½	42¾	44½	46¼	48	50	52
3/8	59½	63	66¾	70¾	74¼	78	81¾	85½	89	92¾	96¼	100¼
5/8	73¼	78	82½	87½	91¾	96½	101	105½	110¼	114¾	119½	124
7/8	79¼	84¼	89¼	94¼	99	104	109	114	119	124	128¾	133¾
1-9	28½	30¼	31¾	33¾	35½	37¼	39	43¾	42½	44½	46	47¾
2-9	44½	47½	55	57¾	55½	58¼	61	63¾	66¾	69½	72¼	75
4-9	64½	68¼	72½	76½	80½	84½	88½	92½	96¼	101½	104½	108½
5-9	70½	74¾	79¼	83¾	88	92½	97	101¼	105¾	110¼	114½	119
7-9	77¾	82¾	87½	92½	97¼	102	107	111¾	116¾	121½	126½	131¼
8-9	79½	84½	89¼	94½	99½	104½	109½	114½	119½	124	129	134
1-11	24¾	26½	27¾	29½	30¾	32½	33¾	35½	37	38½	40	41½
2-11	39¼	41¾	44¼	46¾	49	51½	54	56½	59	61¼	63¾	66¼
3-11	50	53¼	56½	59½	62½	65½	68¾	72	75¼	78½	81½	84½
4-11	58½	62	65½	69½	73	76¾	80¼	84	87¾	91¼	95	98½
5-11	65	69	73	77	81½	85½	89½	93½	97½	101½	105½	109¾
6-11	70	74¼	78¾	83	87½	91¾	96¼	103¾	105	109½	113¾	118¼
7-11	73¼	78½	83	87¾	92¼	97	101½	106¼	110¾	115½	120	124½
8-11	76¾	81½	86½	91	95½	101½	105¼	110¼	115	119¼	124½	129¼
9-11	78½	83½	88½	93½	98¼	103	108	112¾	117¾	122¾	127½	132¼
10-11	79½	84½	89½	94½	99½	104½	109½	114½	119½	124¼	129½	134½
1-12	23¼	24½	26	27½	29	30½	31¾	33¼	34¾	35¼	37¾	39
7-12	67¾	72	76½	80½	84¾	89	93¼	97½	101½	105¾	110	114½
11-12	79½	84½	89½	94½	99½	104½	109½	114½	119½	124½	129½	134½

CONDENSING ENGINE.

EXAMPLE:— 15 pounds pressure on the piston above atmosphere, cut-off at one-fourth the piston's traverse, will be thus; 15 pounds steam and 15 pounds the atmosphere pressure equals 30; then look for 30 pounds at the head of the table, and down the first column for ¼; trace that ¼ under 30 and you will find the average to be 17¾ pounds throughout the stroke.

NON-CONDENSING ENGINE.

EXAMPLE:—45 pounds steam above atmosphere upon the piston, cut-off at one quarter the length of stroke. Thus 45 pounds of steam cut-off at one-fourth the stroke with 15 pounds added make 60 pounds.

Look for 60 on the top line and ¼ on the side, trace that ¼ to the figures under 60 and the average will be found to be 35¾ pounds. Take 16 pounds from 35¾ pounds, for friction (1 lb)., and atmosphere pressure, and there remains 19¾ pounds, the available pressure on the piston.

STEAM.

A cubic inch of water evaporated under an ordinary atmospheric pressure is converted into 1 cubic *foot* of steam (approximately).

The specific gravity of steam (at atmospheric pressure) is .411 that of air at 34° Fahrenheit, and .0006 that of water at same temperature.

27.222 cubic feet of steam weigh 1 pound; 13.817 cubic feet of air weigh 1 pound.

Locomotives average a consumption of 3000 gallons of water per 100 miles run.

The best designed boilers, well set with good draft and skillful firing, will evaporate from 7 to 10 pounds of water per pound of first-class coal. The average result is from 25 to 60 per cent. below this.

In calculating horse-power of Tubular or Flue boilers, consider 15 square feet of heating surface equivalent to one *nominal* horse-power.

Steam engines in economy, vary from 20 to 60 pounds of feed water, and from 2 to 7 pounds of coal per hour per indicated horse-power.

Condensing engines require from 20 to 30 gallons of water to condense the steam represented by every gallon of water evaporated—approximately for most engines, we say, from 1 to 1½ gallons per minute per I. H. P. Jet condensers do not require quite as much water for condensing as surface condensers.

Surface condensers should have about 2 square feet of tube (cooling) surface per horse-power of steam engine.

RATIO OF VACUUM TO TEMPERATURE (Fahrenheit) OF FEED WATER.

0	Inches,	Vacuum	212°	17½	Inches,	Vacuum,	112°
11	"	"	190°	28½	"	"	92°
18	"	"	170°	29	"	"	72°
22½	"	"	150°	29½	"	"	52°
*25	"	"	135°				

*Usually considered the standard point of efficiency--condenser and air pump being well proportioned.

A TABLE OF MULTIPLIERS TO FIND THE LAP AND LEAD, WHEN THE STEAM IS TO BE CUT OFF AT ¼ TO ⅞ths OF STROKE.

Half-Stroke.		Five-eig'hs of the stroke.		Three-fourths of the Stroke.		Seven-eighths of theStroke		
1	2	1	2	1	2	1	2	
lap.	lead.	lap.	lead.	lap.	lead.	lap.	lead	
2.41	.000	1.58	.000	1.000	.000	.540	.000	.00000
2.16	.145	1.41	.124	.893	.105	.477	.089	.00208
2.06	.198	1.35	.170	.851	.146	.450	.123	.00416
1.94	.268	1.27	.231	.795	.200	.413	.170	.00833
1.84	.318	1.21	.276	.754	.240	.385	.204	.01250
1.97	.358	1.16	.312	.723	.271	.363	.232	.01666
1.71	.391	1.12	.342	.691	.299	.344	.257	.02083
1.65	.420	1.08	.368	.668	.322	.327	.277	.02500
1.60	.444	1.05	.391	.644	.343	.313	.296	.02916
1.56	.467	1.02	.412	.623	.362	.298	.313	.03333
1.48	.505	.968	.449	.586	.396	.273	.343	.04166
1.41	.540	.921	.480	.554	.425	.251	.370	.05000
1.35	.570	.881	.508	.526	.451	.232	.393	.05833
1.30	.595	.844	.532	.500	.473	.215	.414	.06666
1.25	.617	.810	.554	.476	.495	.198	.434	.07500
1.21	.638	.779	.572	.454	.514	.183	.452	.08333
1.17	.657	.751	.592	.434	.532	.160	.468	.09166
1.13	.674	.724	.607	.415	.548	.156	.483	1.00000

The distance of the Piston from the end of its stroke when steam is readmitted for the return stroke being equal to half the stroke multiplied by

The lap must be equal to the width of the Steam port multiplied by col 1. The lead must be equal to the width of the Steam port multiplied by col. 2.

EXAMPLE:—Stroke 36 inches; width of port 2 inches; Steam to be cut off at half-stroke; distance of the piston from the end of its stroke when Steam is readmitted for the return stroke, 1.5 inches.

1.5 ÷ 18 = .0833 Find that number or the one nearest to it, in the right hand or last column, and take out the multipliers on the same line under the head half-stroke.

Then 2 × 1.21 = 2.42 inches = the lap.
And 2 × .638 = 1.276 " = the lead.

Table showing the amount of "LAP" required for slide valves, when the Steam is to be worked expansively.

Traverse of the Valve in Inches.	Traverse of the Piston when the Steam is cut-off.								
	1/4	1/3	5-12	1/2	7-12	2/3	3/4	10-12	11-12
	The required Lap.								
2	7/8	3/4	11/16	5/8	9/16	1/2	7/16	3/8	5/16
2 1/2	1 1/16	1	7/8	13/16	11/16	9/16	1/2	7/16	3/8
3	1 1/4	1 3/16	1 1/8	1 1/16	15/16	3/4	5/8	9/16	1/2
3 1/2	1 1/2	1 5/16	1 3/16	1 1/8	1 1/16	1	7/8	3/4	9/16
4	1 3/4	1 9/16	1 7/16	1 5/16	1 1/4	1 1/16	1	13/16	5/8
4 1/2	2	1 13/16	1 9/16	1 1/2	1 3/8	1 1/4	1 1/8	7/8	3/4
5	2 1/8	2	1 13/16	1 9/16	1 1/2	1 3/8	1 1/4	1	13/16
5 1/2	2 5/16	2 3/16	2	1 13/16	1 5/8	1 1/2	1 3/8	1 1/8	7/8
6	2 1/2	2 7/16	2 3/16	2	1 13/16	1 5/8	1 1/2	1 3/16	15/16
6 1/2	2 3/4	2 9/16	2 7/16	2 3/32	2	1 1/8	1 5/8	1 1/4	1
7	3	2 11/16	2 9/16	2 3/8	2 3/32	2	1 3/4	1 7/8	1 1/8
7 1/2	3 3/16	3	2 11/16	2 1/2	2 3/8	2 3/32	2 7/8	1 1/2	1 3/16
8	3 5/16	3 3/16	3	2 5/8	2 1/2	2 3/8	2	1 5/8	1 1/4
8 1/2	3 5/8	3 7/16	3 3/16	2 13/16	2 11/16	2 1/2	2 1/8	1 3/4	1 5/16
9	3 13/16	3 5/8	3 5/16	3	2 13/16	2 11/16	2 1/4	1 7/8	1 3/8
9 1/2	4	3 13/16	3 5/8	3 3/16	3	2 13/16	2 3/8	2	1 7/16
10	4 1/4	4	3 13/16	3 5/16	3 3/16	3	2 1/2	2 1/16	1 1/2
10 1/2	4 7/16	4 1/4	4	3 1/2	3 5/16	3 1/8	2 5/8	2 3/16	1 9/16
11	4 5/8	4 7/16	4 1/4	3 5/8	3 1/2	3 3/8	2 3/4	2 1/4	1 5/8
11 1/2	4 13/16	4 9/16	4 7/16	3 7/8	3 5/8	3 3/8	2 7/8	2 3/8	1 3/4
12	5	4 13/16	4 9/16	4 1/8	4	3 5/8	3	2 1/2	1 7/8

NOTE:—The traverse of the valves being ascertained, and also the amount of cut-off desired, the above table shows the amount of "LAP" required.

TABLE OF CONSTANT NUMBERS, by which to ascertain the AVERAGE PRESSURE of the STEAM against the PISTON for DIFFERENT PRESSURE and POINTS of CUT-OFF, from 1-4 to 7-8 of the stroke.

Point of Cut-off.	Constant Number.	Point of Cut-off.	Constant Number.
1/4	.5965	5/8	.9188
1/3	.6995	2/3	.9370
3/8	.7428	3/4	.9657
1/2	.8465	7/8	.9919

Multiply the pressure in pounds, as shown by the gauge, by the constant number opposite the point of cut-off in the left column. The product is the average.

Table showing usual consumption of coarse anthracite coal and soft wood by different sized engines, 12 hours per day.

Horse-Power.	Pounds of Coal.	Cords of Wood.	Horse-power.	Pounds of Coal.	Cords of Wood.
4	168	1/2	50	2100	6
6	252	3/4	55	2300	6 1/2
8	336	1	60	2520	7 1/4
10	420	1 1/4	65	2730	8
12	504	1 1/2	70	2940	8 1/2
14	588	1 3/4	75	3150	9 1/4
16	672	2	80	3360	9 3/4
18	756	2 1/4	85	3560	10 1/2
20	840	2 1/2	90	3780	11
25	1066	3	95	3990	11 3/4
30	1260	3 1/2	100	4200	12 1/2
35	1458	4 1/4			
40	1680	4 3/4			
45	1896	5 1/2			

Table showing the effluent velocity with which Steam at different pressures, will flow into the atmosphere, or into steam at a lower pressure

Pressure above the atmosphere.	Velocity of escape per Sec.	Pressure above the atmosphere.	Velocity of escape per Sec.
lbs.	feet.	lbs.	feet.
1	540	50	1736
2	698	60	1777
3	814	70	1810
4	905	80	1835
5	981	90	1857
10	1232	100	1874
20	1476	110	1889
30	1601	120	1900
40	1681	130	1909

TABLE of AREAS of CYLINDERS from 1 to 36 ins. DIAM.

Diam. in Ins.	Area in Ins.	Diam. in Ins.	Area in Ins.	Diam. in Ins.	Area in Ins.	Diam in Ins.	Area in Ins
1	.78	5 1/2	23.7	10	78	19	283
1 1/2	1.7	6	28.2	11	95	20	314
2	3.1	6 1/2	33.1	12	113	21	346
2 1/2	4.9	7	38.4	13	132	22	380
3	7.	7 1/2	44.1	14	153	23	415
3 1/2	9.6	8	50.2	15	176	24	452
4	12.5	8 1/2	56.7	16	201	28	615
4 1/2	15.9	9	63.6	17	226	30	706
5	19.6	9 1/2	70.8	18	254	36	1017

To find the area—Multiply the square of the diameter in inches by .7854—For other Areas see page 73.

Table showing length of stroke and number of revolutions for different piston speeds in feet per minute.

Stroke in Ins.	Speed of Piston in feet per minute.								
	200	210	220	230	240	250	260	270	280
	Revolutions.								
2	600	630	660	690	720	750	780	810	840
3	400	420	440	460	480	500	520	540	560
4	300	315	330	345	360	375	390	405	420
5	240	252	264	276	288	300	312	324	336
6	200	210	220	230	240	250	260	270	280
7	179	180	188	197	206	214	223	231	240
8	150	157	165	172	180	187	195	202	210
9	133	140	147	153	160	166	173	180	187
10	120	126	132	138	144	150	156	162	168
11	109	114	120	125	131	136	142	147	153
12	100	105	110	115	120	125	130	135	140
13	92	97	101	106	111	115	120	125	129
14	86	90	94	98	103	107	111	116	120
15	80	84	88	92	96	100	104	108	112
16	75	79	82	87	90	94	97	101	105
17	70	74	78	81	85	88	92	95	99
18	67	70	73	76	80	83	86	90	93

TABLE of UNITS of H. P. for DIFFERENT PISTON SPEEDS.
Indicated Horse-Power for each pound average pressure per square inch, with different Diam. and speed of piston.

Diam. of Cylinder	Speed of Piston in feet per minute.							
	240	300	350	400	450	500	550	600
Ins.								
4	.091	.114	.133	.152	.171	.19	.209	.228
5	.144	.18	.21	.24	.27	.3	.33	.36
6	.205	.256	.299	.34	.385	.428	.471	.513
7	.279	.348	.408	.466	.524	.583	.641	.699
8	.365	.456	.532	.603	.685	.761	.837	.912
9	.462	.577	.674	.77	.866	.963	1.059	1.154
10	.571	.714	.833	.952	1.071	1.39	1.409	1.428
11	.691	.864	1.008	1.152	1.296	1.44	1.58	1.728
12	.820	1.025	1.195	1.366	1.54	1.708	1.884	2.05
13	.964	1.206	1.407	1.608	1.809	2.01	2.211	2.412
14	1.119	1.398	1.631	1.864	2.097	2.331	2.564	2.797
15	1.285	1.606	1.873	2.131	2.409	2.677	2.945	3.212
16	1.461	1.827	2.131	2.436	2.741	3.045	3.349	3.654
17	1.643	2.054	2.396	2.739	3.081	3.424	3.766	4.108
18	1.849	2.312	2.697	3.083	3.468	3.854	4.239	4.264
19	2.061	2.577	3.006	3.436	3.865	4.295	4.724	5.154
20	2.292	2.855	3.331	3.807	4.265	4.759	5.234	5.731
21	2.518	3.148	3.672	4.197	4.722	5.247	5.771	6.296
22	2.764	3.455	4.031	4.607	5.183	5.759	6.334	6.911

Applebys Table showing the number of gallons discharged per minute by single-acting pumps of a given diameter and stroke at 10 strokes per minute.

Diam. of pump bbl. in inches.	LENGTH OF STROKE IN INCHES.												
	1	2	3	4	5	6	7	8	9	10	12	14	15
1	.028	.056	.084	.112	.140	.168	.196	.224	.252	.280	.336	.392	.420
1¼	.044	.088	.132	.176	.220	.264	.308	.352	.396	.44	.528	.616	.660
1½	.063	.126	.189	.252	.315	.378	.441	.504	.567	.63	.756	.882	.945
1¾	.086	.172	.258	.344	.430	.516	.602	.688	.774	.86	1.032	1.204	1.29
2	.113	.226	.339	.452	.565	.678	.791	.904	1.017	1.13	1.356	1.582	1.695
2½	.176	.352	.528	.704	.880	1.056	1.232	1.408	1.574	1.76	2.112	2.464	2.64
3	.254	.508	.762	1.016	1.270	1.524	1.778	2.032	2.286	2.54	3.048	3.55	3.81
3½	.346	.692	1.038	1.384	1.780	2.07	2.42	2.76	3.11	3.46	4.15	4.84	5.19
4	.452	.91	1.35	1.82	2.26	2.71	3.16	3.61	4.06	4.52	5.42	6.32	6.78
4½	.572	1.14	1.71	2.29	2.86	3.43	4.20	4.57	5.14	5.72	6.86	8.0	8.57
5	.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3	7.	8.4	9.8	10.5
5½	.8	1.70	2.55	3.40	4.25	5.10	5.95	6.8	7.65	8.5	10.2	11.9	12.75
6	1.01	2.02	3.03	4.04	5.05	6.06	7.07	8.08	9.09	10.1	12.12	14.14	15.15
7	1.38	2.77	4.15	5.54	6.92	8.31	9.69	11.08	12.06	13.85	16.62	19.38	20.77
8	1.80	3.61	5.42	7.23	9.04	10.85	12.66	14.47	16.28	18.09	21.7	25.32	27.13
9	2.289	4.57	6.86	9.15	11.44	13.73	16.02	18.31	20.60	22.89	27.46	32.04	34.33
10	2.827	5.45	8.48	11.30	14.13	16.96	19.78	22.61	25.44	28.27	32.92	39.56	42.40
12	4.68	8.13	12.20	16.27	20.34	24.40	28.47	32.54	36.61	40.68	48.08	56.94	61.02
15	6.361	12.72	19.08	25.44	31.80	38.16	44.52	50.88	57.24	63.61	76.32	89.04	95.41
18	9.158	18.31	27.47	36.63	45.79	54.94	64.10	73.26	82.42	91.58	109.88	128.2	137.37
20	11.307	22.61	33.92	45.23	56.53	67,84	79.15	90.45	101.76	113.07	135.68	158.3	169.6
24	16.282	32.56	48.48	65.12	81.41	99.69	113.97	130.25	146.53	162.82	195.4	227.9	244.23

The quantities given in the table are in gallons, and are calculated for single-acting pumps at 10 strokes per minute; if required for double-acting pumps the number found in the table should be doubled. The quantity for any other number of strokes may be found by multiplying or dividing the number found in the table.

Table showing the power to raise water to different altitudes, varying from 1 foot to 10.000 feet.

What a H. P. will raise per minute.		2 H. P. will raise per minute.		3 H. P. will raise per minute.		4 H. P. will raise per minute.	
gals. or feet.	feet or gals.	gals. or feet.	feet or gals.	gals. or feet.	feet or gals.	gals. or feet.	feet or gals.
2.500	1	5.000	1	7.500	1	10.000	1
1.250	2	2.500	2	3.750	2	5.000	2
833	3	1.666	3	2.500	3	3.333	3
625	4	1.250	4	1.875	4	2.500	4
500	5	1.000	5	1.500	5	2.000	5
416	6	833	6	1.250	6	1.666	6
357	7	714	7	1.070	7	1.428	7
312	8	625	8	937	8	1.250	8
277	9	555	9	833	9	1,111	9
250	10	500	10	750	10	1,000	10
125	20	250	20	375	20	500	20
83	30	166	30	250	30	333	30
62	40	125	40	187	40	250	40
50	50	100	50	150	50	200	50
41	60	83	60	125	60	166	60
35	70	72	70	107	70	142	70
31	80	62	80	93	80	125	80
27	60	55	90	83	90	111	90
25	100	50	100	75	100	100	100

To find what an 8 Horse-Power will raise, multiply gals. or feet column under 4 Horse-Power by 2 the product will be the number of gals. or feet.

To find what any H. P. will raise, multiply gals. or feet in first column, by the H. P. you have, and the product will be the number of gals. or feet.

CAPACITY OF CISTERNS.—*IN U. S. GALLONS, (2.31 Cubic Inches) FOR EACH 10 INCHES IN DEPTH.*

Feet in Diam.	Gallons.	Feet in Diam.	Gallons.	Feet in Diam.	Gallons.
2	19.5	6	176.25	10	489.20
2½	30.5	6½	206.85	11	592.40
3	44.06	7	239.88	12	705.
3½	59.97	7½	275.40	13	807.4
4	78.33	8	313.33	14	959.6
4½	99.44	8½	353.72	15	1101.6
5	122.40	9	396.56	20	1958.6
5½	148.10	9½	461.40	25	3059.9

TABLE SHOWING THE CAPACITY OF CISTERNS AND TANKS, COMPUTED IN BARRELS OF 31½ GALLONS.

Depth in feet.	DIAMETER IN FEET.								
	5	6	7	8	9	10	11	12	13
5	23.3	33.6	45.7	59.7	75.5	93.2	112.8	134.3	157.6
6	28.0	40.3	54.8	71.7	90.6	111.9	135.4	161.1	189.1
7	32.7	47.0	64.0	83.6	105.7	130.6	158.0	188 0	220.6
8	37.3	53.7	73.1	95.5	120.1	149.2	180.5	214.8	252.1
9	42.0	60.4	82.2	107.4	136.0	167.9	203.1	241.7	283.7
10	46.7	67.1	91.4	119.4	151.1	186.5	225.7	268.6	315.2
11	51.3	73.9	100.5	131.3	166.2	205.1	248.2	295.4	346.7
12	56.0	80.6	109.7	143.2	181.3	223.8	270.8	322.3	378.2
13	60.7	87.3	118.8	155.2	196.4	242.4	293.4	349.1	409.7
14	65.3	94.0	127.9	167.1	211.5	261.1	315.9	376.0	441.3
15	70.0	100.7	137.1	179.0	226.6	279.8	338.5	402.8	472.8
16	74.7	107.4	146.2	191.0	241.7	298.4	361.1	429.7	504.3
17	79.3	114.1	155.4	202.9	256.8	317.0	383.6	456.6	535.8
18	84.0	120.9	164.5	214.8	272.0	335.7	406.2	483.4	567.3
19	88.7	127.6	173.6	226.8	287.0	354.3	428.8	510.3	598.0
20	93.3	134.3	182.8	238.7	302.1	373.0	451.3	537.1	630.4

For cisterns larger in diameter multiply the barrels of half the diameter by four and the product will be the number of barrels which it will contain. Thus 10 feet deep by 20 feet in diameter, ½ of 20 feet is 10 feet, look opposite 10 feet in first column and under 10 feet we find $186.5 \times 4 =$ 746 barrels.

Table showing the power in foot pounds, required to raise a given quantity of water a given height.

Height in feet.	Number of gallons raised per minute.									
	1	2	3	4	5	10	20	30	40	50
1	20	40	60	80	100	175	300	425	550	675
2	30	60	90	120	150	275	500	750	950	1175
3	40	80	120	160	200	375	700	1025	1350	1675
4	50	100	150	200	250	475	900	1325	1750	2175
5	60	120	180	240	300	575	1100	1625	2150	2675
10	110	220	330	440	500	1076	2102	3128	4154	5186
20	210	420	630	840	1050	2076	4102	6128	8154	10180
30	310	620	930	1240	1550	3076	6102	9128	12154	15180
40	410	820	1230	1640	2050	4076	8102	12128	16154	20180
50	510	1020	1530	2040	2550	5076	10102	15128	20154	25180
100	1010	2020	3030	4040	5050	10076	20102	30128	40154	50180

The numbers given in the table are in foot lbs. including allowance for friction.

A foot pound = 1 lb. raised 1 foot high in 1 minute.

A man is capable of exerting 6.000 foot pounds for 10 hours a day. 33.000 ft. lbs. = 1 Horse-Power.

Table showing quantity of water per lineal foot in pumps verticle pipes of different diameters.

Diam. of Pump in Inches.	No. of gal. per lin. ft.	No. of Cu. ft. per lineal foot	Diam. of Pump in Inches.	No. of gal. per lin. ft.	No. of Cu. ft. per lineal foot
2	.136	.0218	8	2.176	.3490
2¼	.172	.0276	8¼	2.314	.3712
2½	.212	.0340	8½	2.456	.3940
2¾	.257	.0412	8¾	2.603	.4175
3	.306	.0490	9	2.754	.4417
3¼	.359	.0576	9¼	2.909	.4666
3½	.416	.0688	9½	3.068	.4923
3¾	.478	.0766	9¾	3.232	.5184
4	.544	.0872	10	3.400	.5454
4¼	.614	.0985	10¼	3.572	.5730
4½	.688	.1104	10½	3.748	.6013
4¾	.767	.1230	10¾	3.929	.6302
5	.850	.1363	11	4.114	.6599
5¼	.937	.1503	11¼	4.303	.6902
5½	1.028	.1649	11½	4.496	.7212
5¾	1.124	.1803	11¾	4.694	.7529
6	1.224	.1963	12	4.896	.7853
6¼	1.328	.2130	12½	5.312	.8521
6½	1.436	.2304	13	5.746	.9217
6¾	1.549	.2489	13½	6.196	.9934
7	1.666	.2672	14	6.664	1.0689
7¼	1.787	.2866	15	7.650	1.2271
7½	1.912	.3067	16	8.704	1.3962
7¾	2.042	.3275	18	11.016	1.7670

AIR IN MOTION.

Velocity of the wind.		Force or pressure per sq. ft. in lbs. avoir.	Common applications of the Force Wind.
Miles per Hour.	Feet per Sec.		
1	1.47	.005	Hardly preceptible.
2	2.93	.020	Just "
3	4.40	.044	
4	5.87	.079	Gentle pleasant winds.
5	7.33	.123	
10	14.67	.492	Pleasant brisk gale.
15	22.00	1.107	
20	29.34	1.968	Very brisk.
25	36.37	3.075	
30	44.01	4.429	High winds.
35	51.34	6.027	
40	58.68	7.873	Very high.
45	66.01	9.963	
50	73.35	12.300	A Storm or Tempest.
60	88.02	17.715	A great storm.
80	117.36	31.400	A hurricane.

TABLE SHOWING NUMBER OF FEET IN SQUARE FRAMES OF DIFFERENT SIZES AND WIDTHS,

Length in Ins.	Width of Mouldings in Inches.								
	1	1½	2	2½	3	3½	4	4½	5
8	2	2⅓	2⅔	3	3⅓	3⅔	4	4⅓	4⅔
10	2⅓	2⅔	3	3⅓	3⅔	4	4⅓	4⅔	5
12	2⅔	3	3⅓	3⅔	4	4⅓	4⅔	5	5⅓
14	3	3⅓	3⅔	4	4⅓	4⅔	5	5⅓	5⅔
16	3⅓	3⅔	4	4⅓	4⅔	5	5⅓	5⅔	6
18	3⅔	4	4⅓	4⅔	5	5⅓	5⅔	6	6⅓
20	4	4⅓	4⅔	5	5⅓	5⅔	6	6⅓	6⅔
22	4⅓	4⅔	5	5⅓	5⅔	6	6⅓	6⅔	7
24	4⅔	5	5⅓	5⅔	6	6⅓	6⅔	7	7⅓
26	5	5⅓	5⅔	6	6⅓	6⅔	7	7⅓	7⅔
28	5⅓	5⅔	6	6⅓	6⅔	7	7⅓	7⅔	8
30	5⅔	6	6⅓	6⅔	7	7⅓	7⅔	8	8⅓
32	6	6⅓	6⅔	7	7⅓	7⅔	8	8⅓	8⅔
34	6⅓	6⅔	7	7⅓	7⅔	8	8⅓	8⅔	9
36	6⅔	7	7⅓	7⅔	8	8⅓	8⅔	9	9⅓
38	7	7⅓	7⅔	8	8⅓	8⅔	9	9⅓	9⅔
40	7⅓	7⅔	8	8⅓	8⅔	9	9⅓	9⅔	10
42	7⅔	8	8⅓	8⅔	9	9⅓	9⅔	10	10⅓
44	8	8⅓	8⅔	9	9⅓	9⅔	10	10⅓	10⅔
46	8⅓	8⅔	9	9⅓	9⅔	10	10⅓	10⅔	11
48	8⅔	9	9⅓	9⅔	10	10⅓	10⅔	11	11⅓
50	9	9⅓	9⅔	10	10⅓	10⅔	11	11⅓	11⅔
52	9⅓	9⅔	10	10⅓	10⅔	11	11⅓	11⅔	12
54	9⅔	10	10⅓	10⅔	11	11⅓	11⅔	12	12⅓
56	10	10⅓	10⅔	11	11⅓	11⅔	12	12⅓	12⅔
58	10⅓	10⅔	11	11⅓	11⅔	12	12⅓	12⅔	13
60	10⅔	11	11⅓	11⅔	12	12⅓	12⅔	13	13⅓
62	11	11⅓	11⅔	12	12⅓	12⅔	13	13⅓	13⅔
64	11⅓	11⅔	12	12⅓	12⅔	13	13⅓	13⅔	14
66	11⅔	12	12⅓	12⅔	13	13⅓	13⅔	14	14⅓

RULE.—Take the number of inches in half the size of a frame, (thus; a frame 22×28 added, making 50 inches), find 50 in the first column, select your width, and you have the number of feet desired.

SURFACE OF BOILER TUBES.

Diam.	Length.	Surface.	Diam.	Length.	Surface.
Ins.	ft. in.	sq. ft.	Ins.	ft. in.	sq. in.
2½	5 0	3.27	3	6 0	4.70
"	5 3	3.42	"	6 3	4.90
"	5 6	3.60	"	6 6	5.10
"	5 9	3.75	"	7 0	5.50
"	6 0	3.90	"	7 6	5.89
"	6 3	4.05	"	8 0	6.28
"	6 6	4.20	"	8 6	6.67

VALUE OF IRON PER TON OF 2.240 POUNDS AT FROM 2c. TO 13c. PER LB.

per lb.	℔ Ton	per lb	℔ Ton.	per lb	℔ Ton	per lb	℔ Ton.
2	$44.80	4¾	$106.40	7½	168.00	10¼	$229.60
2⅛	47.60	4⅞	109.20	7⅝	170.80	10⅜	232.40
2¼	50.40	5	112.00	7¾	173.60	10½	235.20
2⅜	53.20	5⅛	114.80	7⅞	176.40	10⅝	238.00
2½	56.00	5¼	117.60	8	179.20	10¾	240.80
2¾	85.80	5⅜	120.40	8⅛	182.09	10⅞	243.60
2⅝	61.60	5½	123.20	8¼	184.80	11	246.40
2⅞	64.40	5⅝	126.00	8⅜	187.60	11⅛	249.20
3	67.20	5¾	128.80	8½	190.40	11¼	252.00
3⅛	70.00	5⅞	131.60	8⅝	193.20	11⅜	254.80
3¼	72.80	6	134.40	8¾	196.00	11½	257.60
3⅜	75.60	6⅛	137.20	8⅞	198.80	11⅝	260.40
3½	78.40	6¼	140.00	9	201.60	11¾	263.20
3⅝	81.20	6⅜	142.80	9⅛	204.40	11⅞	266.00
3¾	84.00	6½	145.60	9¼	207.20	12	268.80
3⅞	86.80	6⅝	148.40	9⅜	210.00	12⅛	271.60
4	89.60	6¾	151.20	9½	212.80	12¼	274.40
4⅛	92.40	6⅞	154.00	9⅝	215.60	12⅜	277.20
4¼	95.20	7	156.80	9¾	218.40	12½	280.00
4⅜	98.00	7⅛	159 60	9⅞	221.20	12⅝	282.80
4½	100.80	7¼	162.40	10	224.00	12¾	285.60
4⅝	103.60	7⅜	165.20	10⅛	226.80	13	291.20

DEPRECIATION OF MACHINERY.

Per Annum on first Cost.	Depreciation.	Wear and Tear.	Total.
Engines.	6 per ¢	3 per ¢	9 per ¢
Boilers.	10 "	3 "	13 "
Machinery tools.	7½ "	3½ "	11 "
Mill work, shafti'g & gear.	4 "	2½ "	6½ "
Bands and Belts.		45 "	45 "

REGULAR POLYGONS.

No. sid's	Name.	Numbers on square for mitre.
3	Triangle,	12½ and 7¼, mark along *longest* measure.
4	Square,	Any two equal numbers.
5	Pentagon.	7¼ and 10, mark along *shortest* measure.
6	Hexagon.	7¼ and 12½, " " " "
7	Heptagon.	6 " 12½, " " " "
8	Octagon.	2 and 5; or 7 and 17" " "
10	Decagon.	6½ and 20. " " "

Regular polygons are plain figures whose sides are *equal* straight lines. A regular polygon of six sides is often called a six-square, and one of eight sides an eight-square, etc.

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SCEDULE OF U. S. PATENT FEES.

Sec., 4.934 U. S. Rev. Stat. reads: The following shall be rates for patent fees;

On application for patent, except in design cases.	$15.
In design cases for 3 y'rs and 6 mo.	10.
In design cases for 7 years.	15.
In " " " 14 "	30.
Filing caveat.	10.
" disclaimer.	10.
Re-issue application.	30.
On appeal from primary examiners.	10.
On appeal to Commissioner.	20.

CEMENTS.

CAST-IRON SLOWLY SETTING.—Two ounces of sal-ammoniac, 1 ounce sulphur, and 16 ounces of borings or filings of cast-iron, to be mixed well in a mortar, and kept dry. When required for use, take one part of this powder to 20 parts of clear iron borings or filings, mix thoroughly in a mortar; make the mixture into a stiff paste with a little water, and then it is ready for use. A little fine grindstone sand improves the cement.

CAST-IRON QUICKLY SETTING.—One ounce sal-ammoniac, 2 ounces of sulphur, and 80 ounces of iron filings or boring. Mix the same as for "slowly setting."

RED LEAD CEMENT FOR FACE JOINTS.—Equal parts of white and red lead, mixed with linseed-oil to the proper consistency.

FOR LEATHER.—By dissolving in a mixture of 10 parts; of bisulphide of carbon and 1 part of oil of turpentine enough gutta-percha to thicken the composition. The leather must be free from grease, which may be done by placing a cloth between the leather and a hot iron.

The pieces cemented must be pressed together until the cement is dry.

FOR BRASS AND GLASS.—Boil 3 parts of resin with 1 part of caustic soda and 5 parts of water. Add 5 times its weight of plaster of Paris. It sets finely in from ½ to ¾ of an hour. Zinc, white lead, or percipitated chalk may be substituted for plaster, but hardens more slowly.

FOR STONE OR MARBLE.—The best cement for mending marble or any kind of stone, is made by mixing 20 parts of litharge and one part of freshly-burned lime in fine dry powder. This is made into a putty by the addition of linseed-oil. It sets in a few hours, having the appearance of light stone.

FIRE AND WATER-PROOF CEMENT.—To ½ pint of milk, put an equal quantity of vinegar, in order to curdle it; then separate the curd from the whey, and mix the whey with 4 or 5 eggs, beating the whole well together. When it is well mixed, add a little quick lime through a sieve, until it has acquired the consistency of thick paste. With this cement, broken vessels and cracks of all kinds may be mended. It dries quickly, and resists the action of water as well as considerable degree of fire.

FOR FASTENING LEATHER TO IRON, CHINA, OR GLASS.—To 1 quart of glue dissolved in good cider vinegar; add 1 ounce of good Venice turpentine. It should be allowed to simmer about ½ day.

HOW TO MIX A GOOD ADHESIVE CEMENT.—Mix pulverized Gum-Arabic with its weight of finely powdered calcined alum. When mixed with a small quantity of water, it forms a cement which unites wood, paper, porcelain, glass, and crockery very finely. It must be kept dry in powder and moistened only as needed.

FOR CISTERNS AND WATER CASKS.—Melted glue 8 parts; linseed-oil, 4 parts; boiled into varnish with litharge.

This cement hardens in about 48 hours, and renders the joints of wooden cisterns and casks air and water tight.

RUBBER BELTING.—Take 16 parts of Gutta-Percha or India-Rubber; 2 parts common pitch, and 1 part linseed-oil. Melt together, and use hot. This cement will unite leather or rubber that has not been vulcanized.

FOR STEAM JOINTS.—Take 2 parts powdered litharge, very fine sand, 2 parts; slacked quick-lime, 1 part. Mix all together. So use. Mix the proper quantity with boiled linseed-oil, and apply quickly. It gets hard very soon.

Or 10 pounds of ground litharge; 4 pounds of ground Paris-white; ½ pound of yellow ochre and ½ ounce of hemp: Cut into lengths of ½ inch: Mix all together with boiled linseed-oil to the consistency of a stiff putty. This cement resists fire and will set in water.

AMMONIA SHELLAC CEMENT.—As rubber plates and rings are now-a-days used almost exclusively for making connections between steam and other pipes and apparatus, much annoyance is often experienced by the impossibility or imperfection of an air-tight connection. This is obviated entirely by employing a cement which fastens alike well to the rubber and to the metal or wood. Such cement is prepared by a solution of shellac in ammonia. This is best made by soaking pulverized gum-shellac in 10 times its weight of strong ammonia, when a slimy mass is obtained which in three to four weeks, will become liquid without the use of hot water. This softens the rubber and becomes after volatilization of the ammonia, hard and impermeable to gases and fluids.

CEMENTS FOR BELTS.—The cements used for belts may be made by melting together; 1 part shellac; 2 parts pitch; 2 parts linseed-oil; 4 parts India-rubber; 16 parts gutta-percha, until thoroughly incorporated. It is applied warm, in a thin coating, very quickly, and the 2 parts of the belt are properly and firmly clamped together and left until completely set.

CEMENT FOR BELTS.—Of common glue and American isinglass, take equal parts; place in a kettle, add sufficient water to cover the whole. Let them soak 10 hours; then bring the mixture to the boiling point, and add tannin, until the whole becomes soapy or appears like the white of eggs; apply it warm. Buff the grain off the leather where it is to be cemented; rub the joint surfaces solidly together, and let it dry for a few hours.

TRANSPARENT.—A transparent cement may be made by dissolving 75 parts of India-rubber (not vuncanized) in 60 parts of chloroform, and adding to this solution 15 parts of gum mastich. Balsam of fir will also serve the purpose, as it is a strong cement when not exposed to heat. Both the cement and the edges of the article to which it is applied should be previously warmed before joining.

FOR LEATHER, WOOD, ETC.—A cement resisting the action of water both hot and cold, and most of the acids and alkalies. Three parts, by weight, of shellac and 1 part of caoutchouc are to be dissolved in separate vessels, in ether free from alcohol, applying a gentle heat. When fairly dissolved, the 2 solutions are to be mixed. If the glue be thinned by the admixture of ether, and applied as varnish to leather, it renders a joint or seam water-tight.

VARNISHES.

LAC VARNISH.—Five parts of lac, 1 of turpentine, dissolve in 5 times its weight of alcohol; keep warm until fluid, then strain.

SPAR VARNISH.—Boiled oil and resin.

GOLD VARNISH.—Turmeric, 1 drachm; gamboge, 1 dr; oil of turpentine, 1 quart; shellac, 5 ounces· sandarach. 5 ounces; dragons-blood, 7 drachms; with occasional shaking, for 14 days in a warm place, set it aside to fine and pour off the clear.

VARNISH FOR IRON.—Dissolve in 2 pounds of tar-oil ½ pound asphaltum, ½ pound of powdered resin, mix hot and apply cold.

VARNISH FOR METALS.—Dissolve 1 part of bruised copal in 2 parts of strong alcohol. It dries very quickly.

OIL VARNISH.—Dissolve resin in turpentine to about the consistency of treacle; add 2 pints of linseed-oil to 1 of resin and turpentine.

VARNISH FOR WOOD PATTERNS.—Gum-shellac, 3 ounces; and resin, 1½ ounce; dissolved in a pint of wood naphtha.

VARNISH FOR PLASTER CASTS.—A quarter of an ounce of soap is dissolved in a pint of water, and an equal quantity of wax afterwards incorporated. The cast is dipped in this liquid, and after drying a week is polished by rubbing with soft linen. The surface produced in this manner approaches the polish of marble. When intended to resemble bronze, a soap is used, made of linseed-oil and soda colored by the sulphates of Copper and Iron.

VARNISH FOR IRON AND STEEL.—Clear grains of mastic, 10 parts; camphor, 5 parts; sandarach, 15 parts; and elemi, 5 parts; dissolved in a sufficient quantity of alcohol, and apply without heat. This varnish will retain its transparency, and the metallic brilliancy of the articles will not be obscured.

BLACK VARNISH.—Heat to boiling, 10 parts of linseed-oil varnish with burnt umber, 2 parts, and powdered asphaltum, 1 part. When cooled, dilute with spirits of turpentine as required.

A VARNISH TO GILD WITH, WITHOUT GOLD—Take half a pint of spirits of wine, in which you dissolve 1 drachm of saffron, and half a drachm of dragon's-blood, both previously well pulverized together. Add this to a quantity of Shell-lac varnish, and get it on fire with 2 drachms of aloes.

A VARNISH FOR FASTENING THE LEATHER ON TOP ROLLERS IN FACTORIES.—Dissolve 2¾ ounces of Gum Arabic in water, and so much isinglass dissolved in brandy and it is fit for use.

IMITATION GOLD VARNISH.—As a substitute for the expensive "gold varnish" ½ gallon of turpentine, ½ a gill of asphaltum, 2 ounces of yellow aniline, 4 ounces of umber, 1 gallon of turpentine varnish, and ½ pound of gamboge, mixed and boiled for ten hours. This is said to have as good an effect as the gold varnish and is very cheap.

ENAMELS.

WHITE ENAMEL.—Potash 25 parts; arsenic, 14 parts; glass, 13 parts; salt-petre, 12 parts; flint 5 parts; and litharge, 3 parts.

BLACK ENAMEL.—Clay, 2 parts; protoxide of Iron 1 part.

BLUE ENAMEL.—Fine paste, 10 parts; Nitre, 3 parts; color with cobalt.

GREEN ENAMEL.—Frit, 1 pound; oxide of Copper, ½ ounce; red oxide of Iron, 12 grains.

YELLOW ENAMEL.—White lead, 2 parts; alum, white oxide of Antimony, and sal-ammoniac, each 1 part.

GELATINE GLUE.—If gelatine which has been swelled in cold water, be immersed in linseed-oil and heated, it dissolves and forms a glue of remarkable tenacity which when once dry perfectly resists dampness, and two pieces of wood joined by it will separate anywhere else rather than at the joint, ordinary glue may be thus dissolved, and sometimes a small quantity of red-lead in powder is added.

MARINE GLUE.—India-Rubber, 1 part; coal-tar naphtha 8 to 10 parts; shellac, 15 to 20 parts; melted together. Use hot. Glue dissolved in skimmed milk will resist the action of moisture; also glue softened with boiled oil or resin, and its weight of Iron oxide added.

WATER-PROOF GLUE.—Boil 8 parts of common glue with about 30 parts of water, until a strong solution is obtained, add 4½ parts of boiled linseed-oil and let the mixture boil 2 or 3 minutes, stirring it constantly.

ETHER GLUE.—An excellent glue is made by dissolving glue in nitric ether; this fluid will only dissolve a certain amount of glue, consequently the solution cannot be made too thick. The glue solution obtained has about the consistency of molasses, and is doubly as tenacious as that made by hot water. If a few pieces of caoutchouc cut into scraps the size of buck-shot be added and the solution be allowed to stand a few days, being frequently stirred, it will be all the better, and will resist dampness twice as well as glue made with water.

LIQUID GLUE.—Glue, water, and vinegar, each 2 parts. Dissolve in a water bath, then add alcohol, 1 part.

PARCHMENT.—Parchment shavings, 1 pound; water, 6 quarts. Boil until dissolved, then strain and evaporate slowly to the proper consistency.

POLISHING COMPOUNDS.

PASTE FOR CLEANING METALS.—Oxalic acid, 1 part; rotten stone, 6 parts. Mix with equal parts of train-oil and spirits of turpentine.

TO CLEAN BRASS.—Brass that has not been gilt or lacquered may be cleaned by washing with alum boiled in strong lye, in proportion of an ounce to a pint; afterwards rub with strong tripoli.

POLISH FOR SILVER, GOLD, BRASS AND GLASS.—Take 5 pounds of the best Spanish whiting, and with it, mix 3 ounces of alcohol, and then wet to the consistency of dough, make into cakes and dry.

CLEANING SILVER, GLASS, ETC.—Emersons compound for polishing and cleaning glass, silver-plate, tinware and surfaces that permit only slight friction and but little action, consists of water 4 onuces; carbonate of ammonia 1 ounce. When dissolved add 16 ounces of Paris white, with

aniline for coloring. This forms a solid, as the Paris white consists of white lead, all who purchase this compound should beware of using it upon the inside of culinary vessels.

To French Polish Furniture.—For the polish take 1 pint of spirits of wine, add ½ ounce gum shellac, ½ ounce seed lac, ¼ ounce gum sandarac; submit the whole to a gentle heat, frequently shaking it until the gums are dissolved, when it is fit for use. Make a roller of list, put a little of the polish upon it, and cover that with soft linen rags which must be lightly touched in cold-drawn linseed-oil. Rub the wood in a circular direction (not covering too large a piece at one time) until the pores of the wood are filled up; after this rub in the same manner spirits of wine with a little of the polish added to it.

Patent Leather Polish.—A splendid polish for patent leather, which is used as a blacking in the ordinary way and requires no brushes for polishing; is made by boiling well together ½ pound brown sugar, 1 ounce gum-arabic and 2 pounds of ivory black. Allow this mixture to cool and become settled and then bottle it.

For Holes in Castings.—Sal-ammoniac, 2 parts; sulphur in powder, 1 part; powdered iron turnings, 80 parts. Make into a thick paste. The ingredents composing this cement should be kept separate and not mixed until required for use.

To Kill Knots.—Cover them with fresh slacked lime for 24 hours; scrape lime off and lay on a coat of red and white lead mixed with glue-size. Pumice-stone when dry and lay on some paint.

Files (recutting).—Lay dull files in diluted sulphuric acid until they are bit in deep enough.

Watch-Makers Oil, which never corrodes or thickens—Place coils of thin sheet lead in a bottle of olive-oil, expose it to the sun for a few weeks, and pour off the clear oil.

French Polish.—Five ounces of naphtha, 1 ounce of shellac, 1 drachm of myrrh, 10 grains of isinglass, 6 drachms of olive-oil.

Bronzing, or Bronzing Liquid.—Sulphate of Copper, 1 ounce; sweet spirits of nitre, 1 ounce; water, 1 pint. Mix well. In four or five days it will be fit for use.

Brown Tint for Iron and Steel.—Dissolve, in 4 parts; of water, 2 parts of crystallized chloride of iron, 2 parts of chloride of antimony, and 1 part of gallic acid, and apply the solution with a sponge or cloth to the article, and dry it in the air. Repeat this any number of times, according to the depth it is desired to produce. Wash with water and dry, and finally rub the article over with boiled linseed-oil. The metal thus receives a brown tint and resists moisture. The chloride of antimony should be as little acid as possible.

BROWNING FOR GUN BARRELS.—Tincture of muriate of iron, 1 ounce; nitric ether, 1 ounce; sulphate of copper; 4 scruples; rain water, 1 pint. If the process is to be hurried, add 2 or 3 grains of oxymuriate of mercury. When the barrel is finished, let it remain a short time in lime water, to neutralize any acid which may have penetrated; then rub it well with an iron wire scratch-brush.

BRONZING FLUID FOR GUNS.—Nitric acid, sp. gr. 1, 2; pure nitric ether, alcohol, muriate of iron, each 1 part. Mix, then add sulphate of copper 2 parts, dissolved in water 10 parts.

PATINA ANTIQUA BRONZE.—Bronze of a good quality acquires, by oxidation, a fine green tint. Corinthian brass receives, in this way, a beautiful clear, green color. This appearance is imitated by an artificial process, called bronzing. A solution of sal-ammoniac and salt of sorrel in vinegar is used for bronzing metals, any number of layers may be applied, and the shade becomes deeper in proportion to the number applied. For bronzing sculptures of wood, plaster figures, etc. etc., a composition of yellow ochre, Prussian blue, and lamp-black, dissolved in water is employed.

NON-CONDUCTING COVERING FOR STEAM-BOILERS AND PIPES.—Make a thin paste of boiling water and flour, then stir in as much sawdust as it can hold together. After drying it will adhere to iron when slightly warmed, after which several coats may be applied in succession. It may be made water-proof by painting with coal-tar.

FLOUR PASTE.—To make paste that will keep a long time mix with each 100 pounds of flour; 5 pounds of alum, 8 ounces of sulphate of lime, and 2 ounces of oil of sassafras.

PARTING SAND.—Burnt sand scraped from the surface of castings.

LOAM.—Mixture of brick, clay, and old foundry sand.

BLACKENING FOR MOULDS.—Charcoal powder; or, in some instances, fine coal-dust.

BLACK-WASH.—Charcoal, plumbago, and size.

TO SOFTEN HORN.—Take 1 pound, of wood-ashes, add 2 pounds of quick-lime, put them into a quart of water, let the whole boil until reduced to 1-3, then dip a feather into it, if the plume comes off on drawing it out, then it is boiled enough; when settled filter it off, and in the liquor, add shavings of horn, let them soak for 3 days, then rubbing oil on your hands work the horn into a mass, and print or mould it in what ever shape you want.

EASY WAY OF CLEANING THE HANDS FROM DYES ETC.—Take a small quantity of pot-ash or pearl-ash in your

hand, pour into it a small quantity of water, rub it well all over your hands with a little sand, then wash it off, take in your hands a small quantity of chemic (chloride of lime), pour a little water into it, and rub it well on the hands in a semi-liquid state; wash the hands well in water, and they will be clean. If not perfectly clean, repeat the operation.

PRESERVATIVE FOR STEEL.—Caoutchouc, 1 part; turpentine, 16 parts; and boiled oil, 8 parts; well mixed and boiled together, caoutchouc should first be dissolved in the turpentine by gentle heat, and the boiled oil added, it should be applied with a brush, and may be removed by turpentine.

TO PREVENT IRON FROM RUSTING.—Warm it, then rub with white wax; warm again to allow the wax to prevade the entire surface, or immerse the iron in boiled linseed-oil, and allow it to dry upon the metal.

BRAZING.—The edges filed or scraped clean and bright, covered with spelter and powdered borax, and exposed in a clear fire to a heat sufficient to melt the solder.

MIXTURE FOR WELDING STEEL.—One part of sal-ammoniac and 10 parts of borax, pounded together and fused until clear, when it is poured out, and when cool reduce to powder.

ETCHING SOLUTION FOR IRON AND STEEL.—Take 4 of nitric acid, 2 of sal-ammoniac, 1 of sulphate of copper, and 72 parts water. This is by weight.

WATER ANNEALING.—Heat the steel to a red heat, and let it lie a few minutes, until nearly black hot, then throw it into soap suds. Steel in this way, may be annealed softer than by putting in the ashes on the forge.

EVERLASTING PASTE.—Dissolve half a teaspoonful of alum in a pint of water; when it is cold, for it should be heated when the alum is mixed with it, stir in flour enough to make it about as thick as rich cream; do not leave a lump in it; stir in as much powdered rosin as will lie on a cent piece. Put a saucepan on the stove, put a teacupful of boiling water in it, then stir in the mixture; stir it constantly to keep it from burning. Add a few drops of winter-green. When it is about as thick as mush take it from the fire, put it in a jar or glass can and set it where it will be cool. It will become hard, and when needed for use take out a little and soften it with warm water; it will only take a minute or two to do this. This paste will keep a year at least.

STAINING WOODS.

ROSEWOOD.—Boil 8 ounces of logwood in 3 pints of water until reduced to 1½; apply it boiling hot 2 or 3 times, let-

ting it dry each time. Put in the streaks with a camel's hair brush dipped in a solution of copperas and verdigris in a decoction of logwood.

LIGHT MAHOGANY.—Brush over the surface with diluted nitrous acid, and when dry apply with a soft brush the following: Four ounces of dragon's blood, 1 ounce of carbonate of soda, 3 pints of alcohol. Let it stand in a warm place, shake it frequently and then strain.

TO STAIN MUSICAL INSTRUMENTS.—Boil 1 pound of ground Brazil wood in 3 quarts of water for 1 hour; strain it, then add ½ an ounce of cochineal; boil ½ hour longer. This makes a crimson stain.

EBONY.—Wash the wood several times with a solution of sulphate of iron; let it dry, then apply a hot decoction of logwood and nutgalls. When dry wipe it with a wet sponge; and when dry again polish it with linseed-oil.

PURPLE.—Boil a pound of chip logwood in 3 quarts of water for an hour; then add 4 ounces of alum.

BLUE.—Boil 4 parts of alum with 85 parts of water.

TO IMITATE EBONY.—Infuse gall-nuts in vinegar wherein you have soaked rusty nails; then rub your wood with this; let it dry, polish and burnish.

TO PREVENT LOGS AND PLANKS FROM SPLITTING.—Logs and planks split at ends because the exposed surface dries faster than the inside. Saturate muriatic acid with lime, and apply like whitewash to the ends. The chloride of calcium formed attracts moisture from the air, and prevents the spliting.

TURNING OR CUTTING METAL WITH PETROLEUM.—A machinist has discovered that by keeping his turning tools constantly wetted with petroleum, he was able to cut metals and alloys with them, although when the tools were used without the oil, their edges were turned and dulled. The hardest steel can be turned easily if the tools be thus wet with a mixture of 2 parts of petroleum with 1 part of turpentine.

WATER-PROOF BOOTS.—The following is said to have been used by the New England fishermen for over a century: Tallow 4 ounces; rosin and bees-wax, of each 1 ounce; melt together in a gentle heat, and add an equal bulk of neats-foot oil. This is first melted and applied to the boots, rubbing it in before the fire; it will make them soft, and at the same time water-proof.

TRACING PAPER.—Nut-oil, 4 parts; turpentine, 5 parts; mix and apply to the paper, then rub dry with flour and brush it over with ox gall.

TRACING PAPER.—A very good tracing-paper may be made by saturating with a camel-hair pencil the finest tis-

sue paper with the following mixture:—Half an ounce of the balsam of Canada, to one ounce of the spirits of turpentine, shaken well together in a two ounce bottle, it requires no heat. When covered with the mixture, hang the paper on a line to dry; then wash in like manner the other side.

PAPER FOR DRAUGHTSMEN etc.—Powdered tragacanth, 1 part; water 10 parts. Dissolve and strain through clean gauze, then lay it smothly upon the paper, previously stretched upon a board. This paper will take either oil or water color.

TRANSFERRING PAPER.—Take half a sheet of very fine bank post paper, lay it on a clean place and rub it well with the scrapings of red chalk; a small bit of sponge is good for this purpose. Apply the chalk, until the paper is all one color, then with a piece of clean old muslin, rub the greater part of the color from the surface. The color may be renewed occasionally as the marking becomes faint.

BLUE PRINTS FOR COPYING MECHANICAL DRAWINGS ETC.

Take 1⅞ ounces pure Ammonia Citrate of Iron, 8 ounces distilled water or pure rain water. Pure Ferricyanide (Red Prussiate of Potash), 1¼ ounces, 8 ounces distilled water. Mix separately and unite. Keep in yellow bottle or in the dark.

To sensitize paper, moisten it uniformly with the liquid by means of a soft clean camel hair brush and suspend in a dark room to dry. Keep from light.

To print the design or drawing put the sensitized paper on a flat surface and then lay the drawing over it and cover with a pane of glass. Expose to the Sun for 15 to 30 minutes (according to the brightness of the Sun) and then rinse thoroughly with pure rain or distilled water.

FACTS FOR FARMERS.

Table Showing the Quantity of Garden Seeds Required to Plant a Given space.

DESIGNATION.	SPACE AND QUANTITY OF SEEDS.
Asparagus.	1 oz. produces 1000 plants and requires a bed 12 feet square.
" Roots.	1000 plant a bed 4 ft. wide, 225 feet long.
Eng. dwarf beans.	1 qt. plants from 100 to 150 feet of row.
French "	1 " " 250 or 350 of row.
Beans, pole, large.	1 " " 100 hills.
" " small.	1 " " 300 " or 250 feet of row.
Beets.	10 lbs. to the acre; 1 oz. plants 150 feet of row.
Broccoli and Kale	1 oz. gives 2500 plants, and requires 40 square feet of ground.

Cabbage.	Early sorts same as broccoli, and requires 60 square feet of ground.
Cauliflower.	The same as cabbage.
Carrot.	1 oz. to 150 of row.
Celery.	1 oz. gives 7000 plants, and requires 8 square feet of ground.
Cucumber.	1 oz. for 150 hills.
Cress.	1 oz. sows a bed 16 feet square.
Egg Plant	1 oz. gives 2000 plants.
Endive.	1 oz. " 3000 " req'i'es 80 ft. of ground
Leek.	1 oz. " 2000 " " 60 " "
Lettuce.	1 oz. " 7000 " " seed bed of 120 ft.
Melon.	1 oz. for 120 hills.
Nasturtium	1 oz. sows 25 feet of row.
Onion.	1 oz. " 200 " "
Okra.	1 oz. " 200 " "
Parsley.	1 oz. " 200 " "
Parsnip.	1 oz. " 250 " "
Peppers.	1 oz. gives 2500 plants.
Peas.	1 quart sows 120 feet of row.
Pumpkin.	1 oz. to 50 hills.
Radish.	1 oz. to 100 feet.
Salsify.	1 oz. to 150 " of row.
Spinage.	1 oz. to 200 " "
Squash.	1 oz. to 75 hills
Tomato.	1 oz. gives 2500 plants, requiring seed bed of 80 feet.
Turnip.	1 oz. to 2000 feet.
Water melon.	1 oz. to 50 hills.

Table Showing the Number of Plants, Hills, or Trees Contained in an Acre at Epual Distances Apart. From 3 Inches up to 66 Feet.

Distance apart.	No. of plants.	Distance apart.	No. of plants.
3 inches. by. 3 inches.	696.960	4 feet. by 1 foot	10.890
4 " " 4 "	392.040	4 " " 2 feet	5.445
6 " " 6 "	174.240	4 " " 3 "	3.630
9 " " 9 "	77.440	4 " " 4 "	2.722
1 foot " 1 foot	43.560	4½ " " 4½ "	2.151
1½ feet " 1½ feet	19.360	5 " " 1 foot	8.712
2 " " 1 foot	21.780	5 " " 2 feet	4.356
2 " " 2 feet	10.890	5 " " 3 "	2.904
2½ " " 2½ "	6.960	5 " " 4 "	2.178
3 " " 1 foot	14.520	5 " " 5 "	1.742
3 " " 2 feet	7.260	5½ " " 5½ "	1.417
3 " " 3 "	4.840	6 " " 6 "	1.210
3½ " " 3½ "	3.555	6½ " " 6½ "	1.031

Distance apart.	No. of plants.	Distance apart.	No. of plants.
7 feet by 7 feet	881	17 feet by 17	150
8 " " 8 "	680	18 " " 18	134
9 " " 9 "	537	19 " " 19	120
10 " " 10 "	435	20 " " 20	108
11 " " 11 "	361	25 " " 25	69
12 " " 12 "	302	30 " " 30	48
13 " " 13 "	257	33 " " 33	40
14 " " 14 "	222	40 " " 40	27
15 " " 15 "	193	50 " " 50	17
16 " " 16 "	170	60 " " 60	12
16½ " " 16½ "	160	66 " " 66	10

Table Showing the Numtber of Seeds in one Pound, and Weight per Bushel.

NAME.	No. of seeds per pound.	No. of lbs., per bushel.
Wheat.	10,500	58 to 64
Barley.	15,400	48 to 56
Oats.	20,000	38 to 42
Rye.	23,000	56 to 60
Vetches.	8,500	60 to 63
Lentils.	8,200	58 to 60
Beans.	600 to 1,300	60 to 65
Peas,	1.800 to 2,000	60 to 65
Flax seed.	108,000	50 to 60
Turnip seed.	155,000	50 to 56
Rape seed.	118,000	50 to 56
Mustard (white).	75,000	57
Cabbage seed.	128,000	52
Mangel-wurzel.	24,600	20 to 24
Parsnip seed.	97,000	14
Carrot-seed.	257,000	9
Lucern-seed.	205.000	58 to 60
Clover (red).	249,600	60 to 63
" (white).	686,400	59 to 62
Rye-grass (perennial)	334,000	20 to 28
" (Italian).	272,000	13 to 18
Sweet vernal grass.	923,000	8
Buck-wheat.	25.000	42 to 52

Table Showing Quantity per Acre when Planted in Rows or Drills.

Broom Corn.	1 to 1½ bushel.	Onions.	4 to 5 pounds
Beans.	1½ to 2 "	Carrots.	2 to 2½ "
Peas.	1½ to 2 "	Parsnips.	4 to 5 "
Pea-nuts.	1 to 2 "	Beets.	4 to 6 "

Table showing the quantity of seed required to the acre.

Designation.	Quantity of Seed.	Designation.	Quantity of Seed.
Wheat.	1¼ to 2 bu.	Broom Corn.	1 to 1½ bus.
Barley.	1½ " 2½ "	Potatoes.	5 " 10 "
Oats.	2 " 4 "	Timothy.	12 " 24 qts.
Rye.	1 " 2 "	Mustard.	8 " 20 "
Buckwheat.	¾ " 1⅓ "	Herd Grass.	12 " 16 "
Millet.	1 " 1⅓ "	Flat Turnip.	2 " 3 lbs.
Corn.	¼ " 1 "	Red Clover.	10 " 16 "
Beans.	1 " 2 "	White Clover.	3 " 4 "
Peas.	2½ " 3½ "	Blue ,Grass.	10 " 15 "
Hemp.	1 " 1½ "	Orchard "	20 " 30 "
Flax.	½ " 2 "	Carrots.	4 " 5 "
Rice.	2 " 2½ "	Parsnips.	6 " 8 "

NUMBER OF YEARS SEEDS RETAIN THEIR VITALTY.

Vegetables.	years.	Vegetables.	years.
Cucumber.	8 to 10	Asparagus.	2 to 3
Melon.	8 " 10	Beans.	2 " 3
Pumkin.	8 " 10	Carrots.	2 " 3
Squash.	8 " 10	Celery.	2 " 3
Brocoli.	5 " 6	Corn (on cob).	2 " 3
Cauliflower.	5 " 6	Leek.	2 " 3
Artichoke.	5 " 6	Onion.	2 " 3
Endive.	5 " 6	Parsley.	2 " 3
Pea.	5 " 6	Parsnip.	2 " 3
Radish.	4 " 5	Pepper.	2 " 3
Beets.	3 " 4	Tomato.	2 " 3
Cress	3 " 4	Egg Plant.	1 " 2
Lettuce.	3 " 4	HERBS.	
Mustard.	3 " 4		
Okra.	3 " 4	Anise.	3 to 4
Rhubarb.	3 " 4	Caraway.	2
Spinach	3 " 4	Summer Savory.	1 " 2
Turnips.	3 " 5	Sage.	2 " 3

Amount of Seeds, Bulbs, etc., Required to Plant One Acre.

Barley,	2½ bus.
Beans, bunch, in drills 2½ feet	1½ "
Beans, poles, lima, 4×4 feet	20 qts.
Beets, drills 2½ feet	9 lbs.
Broom-corn in drills	12½ "
Cabbage in beds	12 oz.
Cabbage in frames	4 "
Clover, large, red	16 lbs.
Clover, large, with timothy	12 "
Corn, sugar	10 qts.

Corn, field	8 qts.
Cucumbers in hills	8 "
Grass, timothy with clover	6 "
Grass, timothy without clover	10 "
Grass, orchard	25 to 30 "
Grass, red-top	20 to 25 "
Grass, blue	28 "
Grass, rye	20 "
Lawn grass	25 lbs.
Melons, water, 8×8 feet	3 "
Oats	2 bus.
Onions in beds for sets	50 lbs.
Onions in rows for large bulbs	7 "
Pumpkins in hills 8×8 feet	2 qts.
Peas in drills, low varieties	2 bus.
Peas in drills, tall varieties	1 to 1½ "
Peas, broadcast	3 "
Potatoes	8 "
Rye, broadcast	1¾ "
Rye, drilled	1½ "
Turnips in drills 2 feet	3 lbs.
Turnips, broadcast	3 "
Wheat in drills	1¼ bus.
Wheat, broadcast	2 "

Table showing the number of hills or plants on an acre of land, for any distance apart, from 10 inches to 6 feet—the lateral and longitudinal distances being unequal,

	10 in.	12 in.	15 in	18 in	20 in.	2 ft.	2½ ft.	3 ft.	3½ ft	4 ft.
10 in.	62626									
12 "	52272	43560								
15 "	41817	34848	27878							
18 "	34848	29040	23232	19360						
20 "	31363	26136	20908	17424	15681					
2 feet	26136	21780	17424	14520	13068	10890				
2½"	20908	16424	13939	11616	10454	8712	6969			
3 "	17424	14520	11616	9680	8711	7260	5808	4840		
3½"	14935	12446	9953	8197	7467	6223	4976	4148	3565	
4 "	13068	10890	8712	7260	6534	5445	4356	3630	3111	2722
4½"	11616	9680	7744	6453	5808	4840	3872	3226	2767	2420
5 "	10454	8712	6969	5808	5227	4356	3484	2904	2489	2178
5½"	9504	7920	6336	5280	4752	3960	3168	2640	2263	1980
6 "	8712	7260	5808	4840	4356	3630	2904	2420	2074	1865

TO PROTECT NEWLY PLANTED CORN.

To prevent the corn from being destroyed and eaten by chickens, birds, or insects before it grows through the surface of the soil, prepare the seed before planting by sprinkling a sufficient portion of coal tar, (procured at the gas manufactory), through it, stirring so that a portion

will adhere to each grain; then mix among the corn some ground plaster-of-Paris, which will prevent the tar from sticking to the fingers of those who drop the corn, and vegetation will be promoted thereby. The tar and plaster will not injure the corn so as to prevent its growing, by being kept some days after it is so mixed together.

TO PROTECT CORN STALKS FROM MICE.

Sprinkle from four to six bushels of dry white sand upon the root of the stalk before the thatch is put on. The sand is no detriment of the corn, and stacks thus dressed have remained without injury. So very effective is the remedy, that nests of dead young mice have been found where the sand have been used, but not a live mouse could be seen.

MEASURE OF AN ACRE PLOT.

Either of the following measure include about an acre plot.

3	by	53 1/8	Rods.	8	by	20	Rods.
4	"	40	"	9	"	17 7/8	"
5	"	32	"	10	"	16	"
6	"	26 2/3	"	11	"	14 6-11	"
7	"	22 6-7	"	12	"	13 1/3	"

12 Rods 10 ft. and 8 1/2 in square make an Acre.

Square Feet and Feet Square in Fractions of an Acre.

Fractions of an Acre.	Sq. Ft.	Ft. Sq.	Fractions of an Acre.	Sq. Ft.	Ft. Sq.
1-16	2722 1/2	52 1/2	1/2	21780	147 1/2
1/8	5445	73 3/4	1	43560	208 1/4
1/4	10890	104 1/2	2	87120	295 1/4
1/3	14520	120 1/2	3	130680	

HILLS IN AN ACRE OF LAND.

	Hills.		Hills.
40 feet apart.	27	8 feet apart.	680
35 " "	35	6 " "	1210
30 " "	48	5 " "	1742
25 " "	69	3 1/2 " "	3556
20 " "	108	3 " "	4840
15 " "	193	2 1/2 " "	6969
12 " "	302	2 " "	10890
10 " "	435	1 " "	43560

TO ESTIMATE GRAIN CROPS PER ACRE.

Frame together four light sticks, measuring exactly a foot square inside, and with this in one hand, walk into the field and select a spot of fair average yield, and lower the frame square over as many heads as it will inclose, and

shell out the heads thus enclosed carefully, and weigh the grain. It is fair to presume that the proportion will be the 43560th part of an acre's produce. To prove it go through the field and make ten or twenty similar calculations, and estimate by the mean of the whole number of results. It will certainly enable a farmer to make a closer calculation of what a field will produce than he can by guessing.

Comparative Yield of Various Grains, Vegetables and Fruits.

	Lbs., per Acre.		Lbs., per Acre.
Hops.	.442	Grass.	7,000
Wheat.	1,260	Carrots.	6,800
Barley.	1,600	Potatoes.	7,500
Oats.	1,840	Apples.	8,000
Peas.	1,920	Turnips.	8,420
Beans.	2,000	Cinque foil grass.	9,600
Plums.	2,000	Vetches, green.	9,800
Cherries.	2,000	Cabbage.	10,900
Onions.	2,800	Parsnips.	11,200
Hay.	4,000	Mangel Wurzel.	22,000
Pears.	5,000		

CONTENTS OF FIELDS AND LOTS.

To assist farmers in making an estimate of the amount of land in different fields.

220	feet	by	198	feet	of	land.....	equals.	1	acre.
440	"	"	99	"	"	....	"	1	"
110	"	"	369	"	"	....	"	1	"
60	"	"	726	"	"	....	"	1	"
120	"	"	363	"	"	....	"	1	"
240	"	"	181 1/2	"	"	....	"	1	"
200	"	"	108 8/10	"	"	....	"	1/2	"
100	"	"	145 2/10	"	"	....	"	1/3	"
100	"	"	108 9/12	"	"	....	"	1/4	"

A PRACTICAL RULE FOR LAYING PIPE FOR DRAINING LAND.

Soils.	Depth of Pipe.	Distance apart.
Coarse, Gravel Sand.	4 feet 6 inches.....	60 feet.
Light Sand with Gravel.	4 " "	50 "
Light Loam.	3 " 6 "	33 "
Loam with Clay.	3 " 2 "	21 "
" " Gravel.	3 " 3 "	27 "
Sandy Loam.	3 " 9 "	40 "
Soft Clay.	2 " 9 "	21 "
Stiff Clay.	2 " 6 "	15 "

Greatest Fall of Rain is 2 inches per hour—54308.6 gallons per acre.

Showing Number of Acres drained by different sizes of tile, the rainfall being considered as equal to one-half inch in depth each 24 hours.

Rate of Inclination	ACRES DRAINED.						
Feet to one of rise.	2-in. Tile.	3-in. Tile.	4-in. Tile.	6-in. Tile.	8-in. Tile.	10-in. Tile.	12-in. Tile.
1 foot in 10 feet.	6.6	18.9					
1 " 20 "	4.7	13.0	26.8				
1 " 25 "	4.2	11.4	24.0	66.2			
1 " 30 "	3.9	10.9	21.9	61.5	126.4		
1 " 40 "	3.4	9.4	19.0	53.3	109.6	190.5	
1 " 50 "	3.0	8.4	17.0	47.7	98.0	170.4	269.0
1 " 60 "	2.7	7.6	15.6	43.4	90.0	156.0	246.0
1 " 70 "	2.5	6.9	14.5	39.9	83.0	144.4	228.1
1 " 80 "	2.3	6.5	13.4	37.2	77.0	135.0	213.0
1 " 90 "	2.2	6.1	12.6	35.0	72.5	127.0	200.5
1 " 100 "	2.0	5.7	11.9	33.1	69.2	120.6	190.5
1 " 150 "	1.6	4.5	9.5	26.6	56.0	97.3	154.4
1 " 200 "		3.9	8.2	22.8	48.0	83.9	132.5
1 " 250 "		3.5	7.5	20.4	43.4	74.4	117.0
1 " 300 "			6.9	18.4	38.2	65.5	107.0
1 " 400 "			5.9	16.5	34.6	60.3	90.7
1 " 500 "				14.8	30.1	54.0	81.6
1 " 600 "				13.3	28.0	48.6	74.0
1 " 800 "					24.0	41.9	65.0
1 " 1.000 "					21.2	37.2	56.0
1 " 1.500 "						30.8	47.0
1 " 2.000 "							40.8

Showing carrying capacity of different sizes of tile in Gals.

Carrying Capacity—Gallons per Minute.								
Size of pipes.	1½ in. fall per 100 ft.	3 inch fall per 100 ft.	6 inch fall per 100 ft.	9 inch fall per 100 ft.	1 foot fall per 100 ft.	1½ ft. fall per 100 ft.	2 foot fall per 100 ft.	3 foot fall per 100 ft.
2½ in.	14	20	28	34	40	49	55	68
3 "	21	30	42	52	60	74	85	104
4 "	36	52	76	92	108	132	148	184
5 "	54	78	111	134	159	192	219	269
6 "	84	120	169	206	240	294	338	414
8 "	144	208	304	368	432	528	592	736
9 "	232	330	470	570	660	810	930	1140
10 "	267	378	563	655	803	926	1340	1613
12 "	470	680	960	1160	1360	1670	1920	2350
15 "	830	1180	1680	2040	2370	2920	3340	4100
18 "	1300	1850	2630	3200	3740	4600	5270	6470
20 "	1760	2450	3450	4180	4860	5980	6850	8410
24 "	3000	4152	5871	7202	8303	10021	11743	14466

THE NUMBER OF RAILS, RIDERS AND STAKES REQUIRED FOR EVERY TEN RODS OF ZIGZAG FENCE.

Length of Rail.	Deflection from right line.	Length of Panel.	Number of Rails for each 10 Rods.			Number of Stakes.	Number of Riders (single).
			Five Rails high.	Six Rails high.	Seven Rails high.		
Ft.	Ft.	Ft.					
12	6	8	103	123	144	42	21
14	7	10	83	99	116	34	17
16½	8	12	69	84	95	28	14

For longer distances than 10 rods the proper number of rails, etc., may be computed by multiplying. For instance: If 50 rods of fence, multiply the above number by 5; if for 100, multiply by 10, etc. The like rule will apply to the next.

THE NUMBER OF RAILS AND POSTS REQUIRED TO EACH TEN RODS OF POST AND RAIL STRAIGHT FENCE.

Length of Rail.	Length of Panel.	Number of Panels.	Number of Posts.	Number of Rails for each 10 Rods.			
				Five Rails High.	Six Rails High.	Seven Rails High.	Eight Rails High.
Ft.	Ft.						
10	8	20⅝	21	103	123	144	165
12	10	16½	17	83	99	116	133
14	12	13¾	14	69	84	95	109
16½	14½	11⅓	12	57	69	81	93

Contents of Bins and Granaries.

Width and Length in feet.	1 Ft. high.		2 Ft. high.		3 Ft. high.		4 Ft. high.	
	Sti'k'n.	Heap.	Sti'k'n.	Heap.	Sti'k'n.	Heap.	Sti'k'n.	He'p.
3 × 3	7¼	5¾	14½	11½	21¾	17¼		
3 " 4	9¾	7¾	19¼	15½	29	23¼		
3 " 5	12	9¾	24	19¼	36½	29		
3 " 6	14½	11½	29	23¼	43½	34¾		
3 " 7	17	13½	33¾	27	50¾	40½		
3 " 8	19½	15½	38½	30¾	57¾	46¼		
3 " 9	21¾	17¼	43½	34¾	65	52		
3 " 10	24	19¼	48½	38½	72½	57¾		
4 " 4	12¾	10¼	25¾	20½	38½	30¾	51½	41¼
4 " 5	16	12¾	32¼	25¾	48¼	38½	64¼	51¼
4 " 6	19¼	15½	38½	30¾	57¾	46¼	77¼	61¾
4 " 7	22½	18	45	36	67½	54	90	72
4 " 8	25¾	20½	51½	41¼	77¼	61¾	102¾	82¼
4 " 9	29	23¼	57¾	46¼	86¾	69½	115¾	92½
4 " 10	32¼	25¾	64¼	51½	96½	77¼	128½	102¾
5 " 5	20	16	40¼	32¼	60¼	48½	80¼	64¼
5 " 6	24	19¼	48½	38½	72½	57¾	96½	77¼
5 " 7	28¼	22½	56¼	45	84½	67½	112½	90
5 " 8	32¼	25¾	64¼	51½	96½	77¼	128½	102¾
5 " 9	36¼	29	72¼	57¾	108½	86¾	144¾	115¾
5 " 10	40½	32¼	80¼	64¼	120¾	96½	160¾	128½
5 " 11	44¼	35¼	88½	70¾	132½	106	176¾	141½
6 " 6	29	23¼	57¾	46¼	86¾	69½	115¾	92½
6 " 7	33¾	27	67½	54	101¼	81	135	108
6 " 8	38½	31	77¼	61¾	115¾	92½	154¼	123½
6 " 9	43½	34¾	86¾	69½	130¼	104	173½	138½
6 " 10	48¼	38½	96½	77¼	144¾	115¾	192¾	154¼
6 " 11	53	42½	106	84¾	159	127¼	212¼	169¾
7 " 7	39½	31½	78¾	63	118¼	94½	157½	126
7 " 8	45	36	90	72	135	108	180	144
7 " 9	50¾	40½	101¼	81	152	121½	202½	162
7 " 10	56¼	45	112½	90	168¾	135	225	180
7 " 11	62	49½	123¾	99	185¾	148½	247½	198
7 " 12	67½	54	135	108	202½	162	270	216
8 " 8	51½	41¼	102¾	82½	154¼	123½	205¾	164½
8 " 9	57¾	46¼	115¾	92½	173¼	138¾	231½	185½
8 " 10	64¼	51½	128½	102¾	192¾	154¼	257¼	205¾
8 " 11	70¾	56½	141½	113¼	212¼	169¾	282¾	226¼
8 " 12	77¼	61¾	154¼	123½	231½	185¼	308½	246¾
9 " 9	65	52	130¼	104½	195¼	156½	260¼	208¼
9 " 10	72¼	57¾	144¾	115¾	217	173½	289½	231½
9 " 11	79½	63¾	159	127¼	238¾	191	318¼	255½
9 " 12	86¾	69½	173½	138¾	260¼	208½	347¼	277¾
10 " 10	80½	64¼	160¾	128½	241	192¾	321½	257¼
10 " 11	88½	70¾	176¾	141½	265½	212½	353½	282¾
10 " 12	96½	77¼	192¾	154¼	289¼	231½	385¾	308½
11 " 11	97¼	77¾	194½	155½	291¾	233¼	389	311¼
11 " 12	106	84¾	212½	169¾	318¼	254½	424¼	339½
12 " 12	115¾	92½	231½	185¼	347¼	277¾	462¾	370¼

Contents of Bins and Granaries. (*Continued*).

Width and Length in feet.	5 Ft. high.		6 Ft. high.		7 Ft. high.		8 Ft. high.	
	Sti'k'n.	Heap.	Sti'k'n.	Heap.	Sti'k'n.	Heap.	Sti'k'n.	He'p.
5 × 5	100½	80½						
5 " 6	120½	96½						
5 " 7	140¾	112½						
5 " 8	160¾	128½						
5 " 9	180¾	144½						
5 " 10	201	160¾						
5 " 11	221	176¾	173½	138¾				
6 " 6	144¾	115¾	202½	162				
6 " 7	168¾	135	231½	185¼				
6 " 8	192¾	154¼	260¼	208¼				
6 " 9	217	173½	289¼	231½				
6 " 10	241	192¾	318¼	254½				
6 " 11	265¼	212¼	347¼	277¾				
7 " 7	197	157½	236¼	189	275¾	220½		
7 " 8	225	180	270	216	315	252		
7 " 9	253¼	202½	303¾	243	354½	283½		
7 " 10	281¼	225	337½	270	393¾	315		
7 " 11	309½	247½	371¼	297	433¼	346½		
7 " 12	337½	270	405	324	472½	378		
8 " 8	257¼	205¾	308½	246¾	360	288	411½	329¼
8 " 9	289¼	231½	347¼	277¾	405	324	462¾	370½
8 " 10	321½	257¼	385¾	308½	450	360	514¼	411½
8 " 11	353½	282¾	424¼	339½	495	396	565¾	452¾
8 " 12	385¾	308½	462¾	370¼	540	432	617¼	493¾
9 " 9	325¼	260½	390½	312½	455¾	364½	520¾	416½
9 " 10	361½	289¼	434	347¼	506¼	405	578½	462¾
9 " 11	397¾	318¼	477½	381¾	557	445½	636½	511¼
9 " 12	434	347½	520¾	416½	607½	486	694¼	555½
10 " 10	401¾	321½	482¼	385¾	562½	450	642¾	514¼
10 " 11	442	353½	530¼	424¼	618¾	495	707¼	565¾
10 " 12	482¼	385¾	578½	462¾	675	540	771½	617¼
11 " 11	486¼	389	583¼	466¾	680¾	544½	777¾	622¼
11 " 12	530¼	424½	636¼	509¼	742½	590	848¼	678¾
12 " 12	578½	462¾	694¼	555½	810	648	925¾	740½

This table of "Stricken and Heap" bushels is given to the nearest quarter and can be used for deeper bins, than that employed in the table:—Take the contents of half the depth and multiply by 2.

CAPACITY OF BOXES.

A box 16 inches square and 8.4 inches deep, will contain 1 bushel.

A box 16 inches by 8.4 inches wide, and 8 inches deep will contains ½ bushel.

A box 8 inches by 8.4 inches wide, and 8 inches deep will contain 1 peck.

A box 8 inches by 8 inches square, and 4.2 inches deep, will contain 1 gallon.

A box 7 inches by 4 inches wide, and 4.8 inches deep, will contain ½ gallon.

A box 4 inches by 4 inches square and 4.2 inches deep, will contain 1 quart.

A box 24 by 16 inches square, and 28 inches deep will contain a barrel (5 bushels shelled corn).

A box 24 by 16 inches square, and 14 inches deep will contain ½ a barrel.

A box 26 by 16½ inches square, and 8 inches deep, will contain 1 bushel.

A box 4 feet by 7 inches long, 2 feet 4 inches wide, 2 feet 4 inches deep, holds 20 bushels.

CAPACITY OF A FREIGHT CAR.

A load is nominally 10 tons of 20.000 pounds. The following can be carried: whiskey, 70 bbls., salt, 70 bbls., lime, 70 bbls.; flour, 90 bbls.; eggs, 130 to160 bbls.; flour, 200 sacks; wood 6 cords; cattle, 18 to 20 head; hogs, 50 to 60; sheep, 80 to 100; lumber, 6.000 feet; barley, 400 bushels; wheat, 340 bushels; flax seed, 360 bushels; apples, 370 bushels; corn, 400 bushels; Irish potatoes, 430 bushels; oats, 680 bushels; bran, 1.000 bushels; butter, 20.000 pounds; 400 bushels of barley; 300 bushels of sweet potatoes; 200 kegs of nails.

TO MEASURE GRAIN IN BINS.

Multiply the length of the bin in inches by the width in inches, and that by the height in inches and divide by 2150 for struck bushels, and by 2748 for heaped bushels. The quotient will be the number of bushels contained in the bins, or—

TO MEASURE GRAIN IN THE GRANARY.

Divide the cubic feet by 56, multiply by 45, and the result will be struck measure in bushels.

TO MEASURE CORN IN CRIB.

Multiply the length, breadth and height together, in feet, to obtain the cubic feet; multiply this product by 4, and strike off the right figure; and the result will be shelled bushels, nearly.

TO MEASURE CORN.

IN COB.—Two heaping bushels of corn on the cob will make 1 struck bushel of shelled corn. Some claim that 1 and ½ bushels of ear will make 1 bushel of shelled corn. Much will depend upon the kind of corn, shape of the ear, size of the cob, etc.

IN CRIB.—To measure corn in a crib, multiply the length of the crib in inches by the width in inches, and that by the

height of the corn in the crib in inches and divide the product by 2,748 and the quotient will be the number of heaped bushels of ears. If the crib flares at the sides, measure the width at the top and also at the bottom, add the two sums together, and divide by 2, which will give the mean width,

MEASUREMENT OF HAY.

The only method exact of measuring hay is to weigh it, but the rules given below will be found sufficient for ordinary practical purposes:

To Find the Number of Tons of Meadow Hay in Windrows.—Multiply together the length, breadth and height, in yards, and divide the product by 25. The quotient will be the number of tons in the windrow.

To Find the Number of Tons of Hay in a Mow.—Multiply together the length, height and width, in yards, and divide by 15 if the hay be well packed. If the mow be shallow, and the hay recently placed therein, divide by 18, and by any number from 15 to 18, according as the hay is well packed.

To Find the Number of Tons of Hay in Square or Long Stacks.—Multiply the length of the base in yards by the width in yards, and that by half the height in yards, and divide by 15.

To Find the Number of Tons of Hay in a Load.—Multiply together the length, width and height, in yards, and divide the product by 20.

To ascertain the value of a given number of pounds of hay, straw, or other commodity sold by the ton, at a given price per ton, multiply the number of pounds by $\frac{1}{2}$ the price per ton, and point off three figures from the right. The result will be the price of the article.

A ton is 100 cubic feet in the mow; that is, when it has settled down and becomes solid. A truss of *Hay* is, new, 60 pounds, old, 50 pounds, straw, 40 pounds. A load of hay is 36 trusses. A bale of hay is 300 pounds.

TO MEASURE CISTERNS AND CASKS.

Circular Cisterns.—To ascertain the contents of circular cisterns, multiply the square of the diameter in feet by the depth in feet and that product by $\frac{4.7.5}{4.0.0.0}$ for the contents in hogsheads, or by $\frac{3.7.3}{2.0.0.0}$ for barrels, or $4\frac{7}{8}$ for the contents in gallons.

Square Cisterns.—To ascertain the contents of square cisterns multiply the width in feet by the length in feet, and that by the depth in feet, and that again by $\frac{1.5}{1.6.0}$ for hogsheads, or $\frac{1.9}{2.5}$ for barrels, or $7\frac{4.8}{1.0.0}$ for gallons. Another and simple method is to multiply together the length,

width, and depth, in inches, and divide by 231, which will give the contents in gallons.

Cask Gauging.—To measure the contents of cylindrical vessels, multiply the square of the diameter in inches by 34, and that by the height in inches, and point off four figures. The result will be the contents in, or capacity, in wine gallons and decimals of a gallon. For beer gallons multiply by 28 instead of 34. If the cask be only partially filled, multiply by the height of the liquid instead of the height of the cask, to ascertain the actual contents. In ascertaining the diameter, measure the diameter at the bung and at the head, add together, and divide by 2 for the mean diameter.

TO COMPUTE THE WEIGHT OF CATTLE.

Multiply the girth in inches, immediately back of the shoulders, by the length in inches from the square of the buttock to the point of the shoulder blade, and divide the product by 144, which will give the number of superficial feet. If the animal has a girth of from 3 to 5 feet, multiply the number of superficial feet by 16, which will give the weight of the animal. If the girth is from 5 to 7 feet, multiply by 23, and if from 7 to 9 feet, multiply by 31. If less than 3 feet girth, as in the case of small calves, hogs, sheep, etc., multiply by 11. Of course many circumstances, such as the build of the animal, mode of fattening, condition, breed, etc., will influence the weight, but the above will be found approximately correct.

TO TELL THE AGE OF CATTLE.

A cows horn is generally supposed to furnish a correct indication of the age of the animal. This is not always true. However, for ordinary purposes, the following will be found approximately correct.

At two years of age a circle of thick matter begins to form on the animal's horns, which becomes clearly defined at three years of age, when another circle or ring begins to form, and so on year after year. Its age, then, can be determined by counting the number of rings and adding two to their number. The rings on the bulls horns do not show themselves until he is five years old, so to the number of rings we must add five to arrive at his age. Unless the rings are clear and distinct this rule will not apply. Besides, dealers sometimes file off some of the rings of old cattle to make them appear younger.

AGE OF SHEEP AND GOATS.

At 1 year old they have eight front teeth of uniform size. At 2 years of age the two middle ones are supplanted by two large ones. At three a small tooth appears on each side. At four there are six large teeth. At five all the front teeth are large and at six the whole begins to get large.

WEIGHT OF A CUBIC FOOT

of various substances, from which the bulk of a load of one ton may be easily calculated:

	lbs.		lbs.
Cast Iron	450	Common Soil, compact, about	124
Water	62	Clay, about	135
White Oak	52	Brick, about	125
Loose Earth, about	95	Stone, about	170

Legal Weights of Grain, Seed, etc., in Different States.

ARTICLES.	N. Y.	Ohio.	Penn.	Ind.	Wis.	Iowa.	Ill.	Mich.	Conn.	Mass.	R. I.	Ky.	N. J.	Vt.	Mo.	Canada
Wheat, lb.,	60	60	60	60	60	60	60	60	56	60		60	60	60	60	60
Rye,	56	56	56	56	56	56	54	56	56	56		56	56	56	56	56
Corn.	58	56	56	56	56	56	56	56	56	56		56	56	56	52	56
Oats.	32	32	32	32	35	35	32	32	28	30		33	30	32	M	34
Barley.	48	48	47	48	48	48	44	48	45	46		48	48	46	M	48
Buckwheat.	48		48	50	42	52	40	42		46		52	50	46	M	48
Clover seed.	60	64		60	60	60		60				60	64		M	60
Timothy seed.	40	62		45		45		M		M		45			M	48
Flax seed.	55	56		56		56		M		M		56	55		M	56
Hemp seed.	44			44		44										
Blue grass seed.	14			14		14										
Apples, dried.	22	25			28	24		28								22
Peaches, "	32	33			28	33		28								22
Coarse salt.	56	50	85	50		50				70		50			50	56
Fine salt.	56	50	83	50		50				70		50			50	56
Potatoes.	60			60		66			60	60	60			60		
Peas.	60									60						60
Beans.	62	56		60		60				60		60				60
Castor beans.	46			46		46										
Onions.	57			57		57				50	50		52			
Corn meal.				50							50					

The letter "M" shows the sale in that State is by measure instead of weight.

To reduce cubic feet to bushels, struck measure, divide the cubic feet by 56 and multiply by 45.

VALUE OF FOOD FOR DOMESTIC ANIMALS.

The figures below give the comparative number of pounds of each substance to equal in effect that of any standard food--as, for instance, that of hay.

Good hay, to give a certain nourishment, requires				100 lbs.
Good clover hay will give same effect by the use of				95 "
Rye Straw	"	"	"	355 "
Oat Straw	"	"	"	220 "
Potatoes	"	"	"	195 "

Carrots	will	give same	effect by the use of	280 lbs.
Beets	"	"	"	346 "
Ruta Bagas	"	"	"	262 "
Wheat	"	"	"	43 "
Peas	"	"	"	44 "
Beans	"	"	"	46 "
Rye	"	"	"	49 "
Barley	"	"	"	51 "
Indian Corn	"	"	"	56 "
Oats	"	"	"	59 "
Buckwheat	"	"	"	64 "
Oil Cake	"	"	"	64 "

NUTRITIVE QUALITIES OF FODDER.

The proportion of nutritive matter in 100 pounds of the following substances is as follows:

	Flesh Formers.	Fat Formers.
Clover Hay.....in pounds,	13½	30
Timothy.....	9¾	48¾
Corn.....	10	68
Oats.....	12	61
Wheat Bran.....	14	50
Shorts.....	10	56
Buckwheat Bran.....	5½	48
Potatoes.....		21
Apples.....	½	14
Mangels.....	1	9

The whole of these amounts may not be digestible, but they serve to give a good idea of their relative value.

CONSUMPTION OF HAY.

The hay consumed by different animals does not vary greatly from three pounds daily for each hundred pounds weight of the animals. The following table is the result of various experiments by different persons, and will be useful for farmers who wish to determine by calculation beforehand, how their hay will hold out for the winter; 500 cubic feet of timothy hay, in a full bay being about one ton.

Working Horses,	3.08 lbs	Steers,	2.84 lbs
Working Oxen,	2.40 "	Dry Cows,	2.42 "
Milk Cows (Boussingault's),	2.25 "	Pigs (Estimated),	3.00 "
Milk cows (Lincoln's),	2.40 "	Sheep,	3.00 "
Young growing cattle,	3.08 "		

All the articles enumerated in these food tables are estimated as of good quality. If the fodder be of poor quality, more must be allowed.

RELATIVE VALUE OF DIFFERENT FOODS IN STOCK RAISING.

To produce the same effect as 100 pounds of hay will require of the following articles the number of pounds opposite each:

Beets, white	669	pounds.
Turnips	469	"
Rye straw	429	"
Clover, red, uncured	373	"
Clover, red, dry	88	"
Carrots	371	"
Carrot leaves	135	"
Mangolds	368.5	"
Potatoes	350	"
Oat straw	317	"
Lucerne	89	"
Buckwheat	78.5	"
Corn	62.5	"
Oats	59	"
Barley	58	"
Rye	53.5	"
Wheat	44.5	"
Oilcake, linseed	43	"
Peas, dry	37.5	"
Beans	28	"

FOOD FOR POULTRY.

The table shows the percentage of nutriment in different kinds of food for poultry.

There is in Every 100 Parts by Weight of—	Flesh-forming Material, viz., Gluten, etc.	Warmth-giving and Fattening Material viz.		Bone-making Material, or Mineral substance.	Husk, or Fibre.	Water.
		Fat or Oil.	Starch.			
Beans and Peas	25	2	48	2	8	15
Oatmeal	18	6	63	2	2	9
Middlings Thirds, or Fine Sharps	18	6	53	5	4	14
Oats	15	6	47	2	20	10
Wheat	12	3	70	2	1	12
Buckwheat	12	6	58	11½	11	11½
Barley	11	2	60	2	14	11
Indian Corn	11	8	65	1	5	10
Hempseed	10	21	45	2	14	8
Rice	7	A trace	80	A trace		13
Potatoes	6½		41	2		50½
Milk	4½	3	5	¾		86¾

FOOD FOR SHEEP.

The table shows the number of pounds, live weight, and the number of pounds of wool and of tallow, produced by 1,000 pounds of each of the articles named, when used as food for sheep.

KIND OF FOOD.	Increase in weight, lbs.	Wool produced lbs.	Tallow produced lbs.
Barley	136	11½	60
Buckwheat	120	10	33
Corn Meal, wet	129	13½	17½
Mangel-wurzel, raw	38½	5¼	6½
Oats	146	10	42½
Peas	134	14½	41
Potatoes, raw, with salt	46½	6½	12½
Potatoes, raw, without salt	44	6½	11½
Rye, with salt	133	14	35
Rye, without salt	90	12	43
Wheat	155	14	59½

CORN AND HOGS.

A bushel of corn will make 10½ pounds of pork gross. Then—

When corn costs	Pork costs
12½ cents per bushel.	1½ cents per pound.
17 " " "	2 " " "
25 " " "	3 " " "
35 " " "	4 " " "
42 " " "	5 " " "
50 " " "	6 " " "
60 " " "	7 " " "
65 " " "	8 " " "

AGES OF ANIMALS.

Whales, estimated,	1,000 Yrs.	Cow,	20 Yrs.
Elephant,	400 "	Deer,	20 "
Swan,	300 "	Rhinoceros,	20 "
Tortoise.	100 "	Swine,	20 "
Eagle,	100 "	Wolf,	20 "
Raven,	100 "	Cat	15 "
Camel,	100 "	Fox,	15 "
Lion,	70 "	Dog.	10 "
Porpoise,	30 "	Sheep,	10 "
Horse,	20 "	Rabbit.	7 "
Bear,	20 "	Squirrel.	7 "

Careful observations have shown the following to be about the average growth in twelve years, of several varieties of hard wood, when planted in groves and cultivated:

	Inches diameter.	Feet high.
White Maple,	12	30
Ash, Leaf Maple or Box Elder,	12	20
White Willow,	18	35
Lombardy Poplar,	10	40
Blue and White Ash,	10	25
Black Walnut, and Butternut.	10	20

NUTRITION IN FOOD.

The following is "Boussingault's Scale of Nutritive Equivalents," and shows how many parts of the various articles of food in common use it takes to be equal in nutrition to 100 parts of wheat flour:

Wheat Flour,	100	Rye,	111
Wheat.	107	Rice,	177
Barley Meal,	119	Buckwheat,	108
Barley,	130	Maize,	130
White Haricots.	56	Horse Beans,	44
Lentils,	57	Peas,	67
White. Cabbage,	810	Potatoes,	313
Dried do at 212°,	83	Carrots,	777
Oats,	117	Turnips,	1335

WEIGHTS (MISCELLANEOUS).

Bbl. flour weighs		196	pounds.
Salt		280	"
Beef		200	"
Pork		200	"
Fish		200	"
Keg Powder	equals	25	"
Stone of lead or Iron	equals	14	"
Pig of " "	equals	211/2	stone.
1 bush. of Oats		32	pounds.
1 " Barley		48	"
1 " Corn, Rye, or flax seed		56	"
1 " Blue grass		14	"
1 " Castor Beans		46	"
1 " Hemp seed		44	"
1 " Wheat, beans, clover-seed, peas, or potatoes		60	"
1 " Timothy seed		45	"
1 " Onions		57	"
1 " Apples, or dried peaches.		28	"
1 " Salt		50	"
A sack of wool		308	"
A pack " " (for a horse)		240	"

A bale of cotton is 400 pounds, but it is put up in different States varying from 280 to 720 pounds. Sea Island cotton is put up in sacks of 300 pounds.

AGES ATTAINED BY BIRDS.

Blackbird lives	13 yrs.	Parrot lives	65 yrs.
Blackcap lives	15 "	Partridge lives	15 "
Canary lives	24 "	Peacock lives	24 "
Crane lives	27 "	Pelican lives	58 "
Crow lives	100 "	Pheasant lives	15 "
Eagle lives	100 "	Pigeon lives	20 "
Fowl (common) lives	12 "	Raven lives	100 "
Goldfinch lives	15 "	Robin lives	12 "
Goose lives	50 "	Skylark lives	30 "
Heron lives	60 "	Sparrow Hawk lives	40 "
Lark lives	18 "	Swan lives	100 "
Linnet lives.	23 "	Thrush lives	10 "
Nightingale lives	18 "	Wren lives	3 "

FRESH WATER.

The component parts, by weight and measure, is—Oxygen 88.9 weight, and 1 by measure; hydrogen 11.1 weight, and 2 by measure. One cubic inch of distilled water at its maximum density, 39.83, the barometer 30 inches, weighs 252.7 grains. A cubic foot weighs 62.5 pounds.

AMOUNT OF OIL IN SEEDS.

Kinds of Seed.	Per cent oil.	Kinds of Seed	Per cent oil.
Rapeseed	55	Oats	6½
Sweet Almond	47	Clover hay	5
Turnip seed	45	Wheat bran	4
White mustard	37	Oat-straw	4
Bitter Almond	37	Meadow hay	3½
Hempseed	19	Wheat-straw	3
Linseed	17	Wheat flour	3
Indian corn	7	Barley	2½

THE ENGLISH QUARTER, at which wheat is quoted in the English reports, is 560 pounds, or ¼ of the ton gross weight of 2,240 lbs. The English legal bushel is 70 pounds, and consequently 8 of those bushels is a quarter—equal to 9½ of our statue bushels of 60 pounds.

HOUSEHOLD WEIGHTS AND MEASURES.

1 Teaspoonful equals 1 dram.
1 dessertspoonful equal 2 teaspoonfuls, or 2 drams.
1 tablespoonful equals 2 dessertspoonfuls, or 4 teaspoonfuls.
2 tablespoonfuls equal 8 teaspoonfuls, or 1 ounce.
1 common size wineglassful equal 2 ounces, or ½ gill.
A tea cup is estimated to hold 4 fluid ounces, or 1 gill.

1 pound of wheat is equal to about 1 quart.
1 pound and 2 ounces of Indian meal is equal to 1 quart.
1 pound of soft butter is equal to about 1 pint.
1 pound of sugar is equal to about 1 pint.

TOWNSHIP PLAT.

*Township*_____ *Range*_____

_____ *County*,_____

NORTH

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16*	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

WEST *EAST*

SOUTH

**School section.*

A township is 6 miles square = 36 sections.
A section " 1 " " = 640 acres.
¼ " " ½ " " = 160 "
1-16 " " ¼ " " = 40 "

Hence a township contains 23,040 acres. The smallest tract of land sold by the government is a "quarter-quarter section," which contains 40 acres. The sections are numbered from 1 to 36 commencing at the north-east corner.

Any citizen (or foreigner who has declared his intention to become one), who has actually settled upon an

unappropriated quarter section (160 acres), and has erected a dwelling-house thereon, acquires the right of "pre-emption," that is, the right to purchase that 160 acre plot at the *minimum price*, though he had not located the tract before his settlement. He is permitted to take up, without payment of any price, except certain fees, 160 acres of $1.25 land, or 80 acres of $2.50 land, as a homestead. But the patent or deed will not be issued until he has resided on it for five years. The "patent" or deed is issued by the U. S. Land Commisioner.

THE CENTER OF POPULATION.

The centre of population of the United States is stedily moving westward, at the rate of fifty miles every ten years. The following is the centre point at each census:

1790	22	miles east of Baltimore.
1800	18	" west of Baltimore.
1810	40	" north-west of Washington.
1820	16	" north of Woodstock, Va
1830	19	" west by south-west Moorefield, W. Va.
1840	16	" west of Clarksburg W. Va.
1850	23	" south-east Parkersburg, W. Va.
1860	20	" south of Chillicothe, O.
1870	48	" east by north of Cincinnati.
1880	8	" west by south of Cincinnati.

POWER OF AN ORDINARY MAN.

1 man can raise 10 pounds, 10 feet, in a second, 10 hours a day.
1 man can raise 100 pounds 1 foot.
1 man can draw on a level 640 pounds.
A man can press with hands equal to 110 pounds.
A man's force, drawing horizontally, 110 pounds.
A man can lift with both hands 236 pounds.
A man can support on his shoulders 330 pounds.
5 men working 10 hours a day are equal to 1 horse working 8 hours.
3 men carrying 100 pounds each will ascend a hill quicker than 1 horse carrying 300 pounds.
A man's strength is greater in raising a weight when his own weight is to that of his load as four is to three.

POWER OF A HORSE.

1 horse can raise 150 pounds 220 feet high in a minute: 8 hours a day.
1 horse-power is reckoned at from 30.000 to 36.000 pounds, raised 1 foot high per minute.
1 horse's force drawing horizontally is estimated at 770 pounds.
1 horse can draw on a level 4480 pounds,—2 tons—equal to 7 men.

FORCE REQUISITE TO MOVE A BODY.

A stone along a rough chiseled floor require's ⅔ of its weight. The same on rollers, 1-32.

A stone along a wooden floor, 3-5 of its weight. The same on rollers 1-40.

DISTANCE IN FEET GONE BY IN A SECOND.

A man walking, 4; a horse, harnessed, 12; a ship, 14; a steamship, 18; a reindeer on ice, 26; a race horse, 43; a hare, 88; a locomotive engine, 117; a 24 pound cannon ball, 1.300; the moon, 3.300; the earth, 99.733; an eagle, 117; a hawk, 50; a crow, 36.

The electric telegraph, 1.520.640.000, or more than eleven times around the world.

A swift bird would be 3 weeks in flying round the world.

Light travels about 192.000 miles in a second.

Light could pass round the earth in the 18th of a second.

SOUND.

Sound passes	through air in a second	1.130 ft.
" "	along water	4.900 "
" "	Cast-Iron	11.090 "
" "	Steel	17.000 "
" "	Glass	18.000 "
" "	Wood	4636 to 17.000 "

Cold air conducts sound better than warm.

MEASURES OF ROCK AND EARTH.

25 cubic feet of sand equal		1 ton.
18 " "	Earth	1 "
17 " "	Clay	1 "
13 " "	Quartz, unbroken in lode	1 "
18 " "	Gravel or earth before digging equals	27

cubic feet when dug.

20 cubic feet of quartz, broken (of ordinary fineness from the lode), equals one ton, contract measurement.

RAILWAY SIGNAL CODE.

One whistle signifies "down brakes." Two whistles signify "off brakes," Three whistles signify "back up," Continued whistles signify "danger." Rapid short whistles "a cattle alarm." A sweeping parting of the hands on the level with the eyes, signifies "go ahead." Downward motion of the hands with extended arms, signifies "stop." Beckoning motion of one hand, signifies "back." Red flag waved up the track, signifies "danger." Red flag stuck up by the roadside, signifies "danger ahead." Red flag carried on a locomotive, signifies "an engine following." Red flag hoisted at a station, is a signal to "stop." Lanterns at night raised and lowered vertically, is a signal to "start." Lanterns swung at right angles across the track, means "stop." Lanterns swung in a circle, signifies "back the train."

REMARKS ON USING FILES.

A new file should always be used with a light pressure on the work till the needle-like points of the teeth are worn away; after this, a much heavier pressure may be used with much less danger of breaking off the teeth at their base. Many new files are violently diminished half their efficiency by a few careless strokes when first applied to the work.

Do not use a new file on the chilled and gritty skin of castings, or on a weld where borax or any vitreous fluxes have been employed—no file can endure such usage.

Every filer should keep a worn file with which first to attack the rough, gritty or oxydized surface of iron work, and thereby pave the way for a more efficient work with his sharp files. A piece of gritty or chilled casting that would rapidly destroy the cutting qualities of a new file, would produce scarcely any damaging effect to a worn one.

In filing steel, better results can generally be obtained by using files of a grade not coarser than "2d cut;" finer grades being employed according to the finish and delicacy of the work under manipulation.

Parties using files should always seek to discover the fitness or adaptibility of cut and form of files especially suited to their work. No one should expect the best results from a file on brass or spelter which was intended for use on iron or steel.

SHRINKAGE OF CASTINGS.

Iron, Small cylinders.	=	1-16 in. per foot.
" Pipes	=	1/8 " " "
" Girders, Beams, etc.	=	1/8 " in 15 Ins.
" Large cylinder the contraction		
" of diameter at top	=	1-16 " per foot.
" Ditto at bottom	=	1/2 " " "
" " in length	=	1/8 " in 16 Ins.
Brass, thin	=	1/8 " in 9 "
" thick	=	1/8 " in 10 "
Zinc	=	5-16 " in a foot.
Lead	=	5-16 " in " "
Copper	=	3-16 " in " "
Bismuth	=	5-32 " in " "

SPEED OF SAWS.

To ascertain the proper number of revolutions per minute of any size saw, divide 36.000 by the diameter of the saw in inches, thus—36.000 ÷ 60 = 600, the number of revolutions a 60 inch saw should make.

WEIGHT OF GRINDSTONES.—RULE:—Square the diameter (in inches) multiply by thickness (in inches); then by the decimal .06363; the product will be the weight of the stone in pounds.

TO ASCERTAIN THE DEGREE OF HEAT OF STEEL.

Steel becomes a very faint yellow at	(Fahr).	430°
Straw color		450
Full yellow		470
Brown		490
Brown with purple spots		510
Purple		530
Blue		550
Full blue		560
Dark blue verging on black		600

AVERAGE OF THE LINEAL EXPANSION OF A FEW METALS FROM 32° TO 212°.

Name.	Increased length at 212°.	Name.	Increased length at 212°
Zinc sheet	1 part in 340	Iron	1 part in 812
" cast	" 322	Antimony	" 923
Lead	" 351	Palladium	" 1000
Tin pure	" 403	Platinum	" 1167
" impure	" 516	Glass	" 1160
Silver	" 524	Marble	" 2833
Copper	" 581	Iron soft	" 818
Brass	" 584	Iron cast	" 900
Gold	" 682	Steel tempered.	" 806
Bismuth	" 719	Steel	" 926

Quantity of water that will flow through a pipe 500 feet long in 24 hours, with a fall of 10 feet.

3/8	inches	bore	576	gallons.
1/2	"	"	1,150	"
5/8	"	"	2,040	"
3/4	"	"	3,200	"
1	"	"	6,624	"
1 1/4	"	"	10,000	"

METAL IN THEIR PROBABLE ORDER OF THEIR HARDNESS.

Mercury, Sodium, Potassium, Lead, Zinc, Tin, Antimony, Gold. Silver, Cadmium, Bismuth, Tellurium, Copper, Copper and Zinc, (Brass) Platinum, Copper and Tin, (gun metal) Palladium, Iron, Cobalt. Nickel, Crude Iron, (grey) Steel, (soft) Steel, (hardened) Manganese, Titanium, Crude Iron, (white) Chromium, Rhodium, Iridium, Osminum, Hardest steel varying from white iron to top of list.

The following Table Represents the pressure in pounds on the square inch at a given depth of water.

20	Feet	8 1/2 lbs.	70	Feet	30 1/2 lbs.	120	Feet	52 1/4 lbs.
30	"	12 3/4 "	80	"	34 3/4 "	130	"	56 1/2 "
40	"	17 1/4 "	90	"	39 "	140	"	60 3/4 "
50	"	21 3/4 "	100	"	43 1/2 "	150	"	65 1/4 "
60	"	26 1/4 "	110	"	47 3/4 "			

SOLDERS.

For lead, one of tin and one and one-half of lead.
For tin, one of tin and two of lead.
For pewter, two of tin and one of lead.
For brazing (hardest), three of copper and one of zinc.
For brazing (hard), one of copper and one of zinc.
For brazing (soft), one of tin, four of copper, and three of zinc; or, two of tin and one of antimony.
For silver (hardest), four of fine silver, and one of copper.
For silver (hard), three of silver one part brass wire.
For silver (softest), two of silver and one of brass wire.
For gold (hardest), four of copper seven of silver and eighty-nine of gold.
For gold (hard), sixty-six of copper and thirty-four of zinc.
For gold (soft), sixty-six of tin and thirty-four of lead.
For iron, sixty-six of copper, 33 of zinc and one of antimony.
For copper, fifty-three of copper and forty-seven of tin.
For steel, thirteen of copper, five of zinc and eighty-two of silver.
For brass, forty-seven of copper forty-seven of zinc.

FLUXES FOR SOLDERING OR WELDING.

For iron or steel, borax or sal-ammoniac,
For tinned iron, resin or chloride of zinc.
For copper and brass, sal-ammoniac or chloride of zinc.
For zinc, chloride of zinc.
For lead, tallow or resin.
For lead and tin pipes, resin and sweet oil.

ACTUAL HORSE-POWER OF ENGINES.

RULE:—Multiply the area of the piston by the pressure per square inch; the product by the speed of the piston per minute, equals the force in pounds; this last divided by 33.000 equals the actual horse-power, including the friction.

SIMPLE RULE TO ASCERTAIN HORSE-POWER OF STEAM ENGINE.—Area of cylinder in inches multiply by pounds of steam in boiler, less 20 per cent off, the remainder by speed of piston in feet per minute; divide the product by 33.000

Thus: engine 20-inch cylinder (area 314 inches), boiler pressure 80 pounds, less 20 per cent off=64 pounds, speed of piston 250 feet per minute.

Then: $314 \times 64 \times 250 \div 33.000 = 152$ H. P.

EASY RULE FOR FINDING THE AREA OF A CIRCLE.

A short and easy method of finding the area of a circle, is to multiply the square of the diameter by 7 and divide by 9, and you will have the area (nearly). This rule does

not give it exact; it falls a little short, but is near enough for all ordinary purposes.

To find the circumference when the diameter is given.—Multiply the diameter by 22 and divide by 7, and you will have the circumference (nearly).

EFFECTS OF HEAT.

		Degrees Fahr.
Fine Gold	Melts	2590
" Silver	"	1860
Copper	"	2548
Wrought Iron	"	3980
Cast "	"	3479
Glass	"	2377
Brass	"	1900
Antimony	"	951
Bismuth.	"	476
Cadmium	"	600
Steel	"	250
Lead	"	600
Tin	"	424
Mercury boils	"	600
" volatilizes		806
Platinum	"	4561
Zinc	"	766
Mercury	"	39
Bronze (100 copper 10 tin)	"	1652
Sodium	"	190
Potassium	"	136
Nickel	"	3950
Tellerium	"	850
Indium	"	349

BLASTING.

In small blasts 1 pound of powder will loosen about 4½ tons.

In large blasts 1 pound of powder will loosen about 2¾ tons.

Inclosing 50 or 60 pounds of powder, in a resisting bag hung or propped up against a gate or barrier, will demolish any ordinary construction.

One man can bore, with a bit 1 inch in diameter, from 50 to 100 inches, per day of 10 hours in granite, or 300 to 400 inches, per day in lime stone,

Two strikers and a holder can bore with a bit 2 inches in diameter 10 feet in a day in rock of medium hardness.

COLORS FOR DRAWING.

MATERIAL.	COLOR.
Brass.	Gamboge.
Brick.	Carmine.
Cast-Iron.	Neutral tint.
Clay.	Burnt umber.
Concrete.	Sepia with dark spots.
Earth.	Burnt umber light.
Copper.	Lake and burnt sienna.
Granite,	Indian Ink light.
Lead,	" Ink & Prussian blue
Steel.	Light blue and lake.
Water.	Cobalt or Verdigris.
Woods.	Burnt Sienna, deep and light for dark and light wood.
Wrought-Iron.	Prussian blue, light.

STRENGTH OF ICE.

Ice two inches thick will bear men on foot; four inches, men on horse back; six inches thick will bear cattle and teams with light loads; eight inches thick, teams with heavy loads. Ten inches will sustain a pressure of 1.000 pounds per square foot. The above is on the supposition that the ice is sound, and not "snow-ice."

COMPARATIVE VALUE OF WOOD FOR FUEL.

Taking shell-bark hickory as the highest standard, and calling that 100, other trees will compare with it for burning purposes, as follows: shell-bark hickory, 100; pignut hickory, 95; white oak, 84; white ash, 77; dogwood, 75; scrub oak, 73; white hazel, 72; apple tree, 70; white beach 69; black birch, 65; hard maple, 65; black walnut, 62; yellow oak, 60; white elm, 58; red oak, 56; red cedar, 56; wild cherry, 55; yellow pine, 54; chestnut, 52; yellow poplar, 51; butternut, 43; white birch, 43; white pine, 30.

THE SIZES OF SKATES.

COMPARE WITH SIZES OF SHOES AS FOLLOWS.

Skates, Ins.	7	7½	8	8½	9	9½	10	10½	11	11½
Shoes, No.	9½	11	12½	1	2½	4	5½	7½	9	10½

FLY WHEELS.

A fly-wheel should always have high velocity.

The diameter should be from 3 to 4 times that of the stroke of the driving engine.

The weight of the rim should be about 85 to 95 pounds per actual horse-power, the momentum of the wheel being 4½ times that of the piston.

When the engine to which a fly-wheel is to be attached is single-acting, it is customery to make the weight of the wheel 5 times greater than when it is to be attached to a double-acting engine. The weight of a fly-wheel in engines that are subjected to irregular motions, as in a cotton-press, rolling-mill, etc., must be greater than in the others where so sudden a check is not experienced.

PILING.

Piles may be loaded to 1000 pounds per square inch of head, if driven to firm bottom.

In sandy soil, the greatest force of a pile-driver will not drive a pile over 15 feet.

MASONRY.

Concrete or Beton should be thrown, or let fall from a height of at least 10 feet, or well beaten down. The average weight of brick-work in mortar is about 102 pounds per cubic foot.

A Foot Soldier Travels in One Minute.

Common time,	90	steps	equals	70	yards.
In quick time,	110	"	"	86	"
In double quick time	140	"	"	110	"

He occupies in the ranks a front of 20 inches, and a depth of 13, without a knapsack; the interval between the ranks is 13 inches. Average weight of men, 150 pounds each. Five men can stand in a space of 1 square yard.

Table of Proportions of the Circle and its Equal.

The diameter of any circle $\times$ 3.1416 = the circumference.

The circumference of a circle $\times$ ($\frac{1}{3.1416}$ = 0.31831) = the diameter.

The square of the diameter $\times$ ($\frac{3.1416}{4}$ = 0.7854) = the area.

The square of the circumference $\times \left(\frac{0.7854}{3.1416^2} = 0.07958\right)$ = the area.

The diameter of a circle $\times$ ($\sqrt{0.7854}$ = 0.8862) = side of equal sqnare.

The circumference of a circle $\times$ ($\sqrt{0.07958}$ = 0.2821) = side of equal square.

The side of any square $\times$ ($\frac{1}{0.2821}$ = 3.545) = circumference of equal circle.

The side of any square $\times$ ($\frac{1}{0.8862}$ = 1.1284) = diameter of equal circle.

Square of side $\times$ ($\frac{1}{0.7854}$ = 1.27324366) = square of diameter of equal circle equal so called round inches.

Round inches $\times$ ($\frac{0.7854}{144}$ = 0.0546) = square feet.

Square of diameter of equal circle $\times$ 0.7854 = square side.

MENSURATION OF SURFACES.

Area of any parallelogram = base × perpendicular height.

Area of any triangle = base × ½ perpendicular height.
Area of section of circle = arc × ½ radius.

Area of segment of circle=area of sector of equal radius, less area of triangle.

Area of parabola = base × ⅔ height.

Area of ellipse=longest diameter × shortest diameter× .7854.

Area of any regular polygon=sum of its sides× perpendicular from its centre to one of its sides, divided by 2.

Surface of cylinder = area of both ends + height × circumference.

Surface of segment = height of segment × whole circumference of sphere of which it is a part.

Cubic contents of a cylinder=area of one end × length.

MENSURATION OF SOLIDS.

Cylinder = area of one end × length.

Sphere = cube of diameter × .5236.

Segment of sphere = square root of the height added to three times the square of radius of base × by height and by .5236.

Cone of pyramid = area of base × ⅓ perpendicular height.

Frustrum of a cone=product of diameter of both ends+ sum of their squares, × perpendicular height × .2618.

Frustrum of a pyramid=sum of the areas of the two ends + square root of their product, × by ⅓ of the perpendicular height.

Solidity of a wedge = area of base × ½ perpendicular height.

Frustrum of a wedge=½ perpendicular height×sum of the areas of the two ends.

Solidity of a ring=thickness + inner diameter,× square of thickness, × 2.4674.

To Find the Diameter and the Breaking Strain of a Bolt.

Multiply the area of 1 □ inch by 20, of 2 □ inch by 19, of 3 □ inch by 18, of 4 □ inch by 17, of 5 □ inch by 16, of 6 □ inch by 15, etc., *for Upset Bolts;* but with 12.6 for 1 □ inch, 12.54 for 2 □ inch, 12.50 for 3 □ inch, 12.31 for 4 □ inch, 11.90 for 5 □ inch, and 11.34 for 6 □ inch, *for common, not Upset Bolts.* The result will be the net breaking weight, which is to be divided by the required factor of safety.

EXAMPLE:—What weight can a 2 inch bolt carry before breaking with a factor of 3?

Area of $2=3.1416 \times \frac{1^2}{3} = 19.9$ tons if upset, or $\frac{3.1416}{5} \times 12.54 = 13.13$ if not upset.

What size of Bolt is required to carry 19.9 tons?

$19.9 \times \frac{3}{19} = 3.142 = 2$ inch round bolt upset. $19.9 \times \frac{3}{12.54} = 4.76 = 2.45$ inch round, not upset.

RULES FOR WEIGHTS OF CASTINGS.

Multiply the weight of the pattern by { 12 for Cast-Iron, / 13 " Brass, / 19 " Lead, / 12.2 " Tin, / 11.4 " Zinc, } and the product is the weight of the casting.

SHRINKAGE IN CASTINGS.

PATTERN MAKERS RULE. { Cast-Iron, 1/8 / Brass, 3-16 / Lead, 1/8 / Tin, 1-12 / Zinc, 3-16 } of an inch longer per lineal foot.

REDUCTION FOR ROUND CORES AND CORE PRINTS.

RULE:—Multiply the square of the diameter by the length of the core in inches, and the product by 0.017 is the weight of the Pine Core to be deducted from the weight of the pattern.

SHIPPING ADMEASUREMENT.

REGISTER TON.—For Register tonnage or for measurement of the entire internal capacity of a vessel: 100 cubic feet = 1 Registered Ton.

This number is arbitrarily assumed to facilitate computation.

Shipping Ton for the Measurement of Cargo:

40 cubic feet = { 1 U. S. shipping ton. / 31.16 Imperial bushels. / 32.143 U. S. " }

42 cubic feet = { 1 British shipping ton. / 32.719 Imperial bushels. / 33.75 U. S. " }

HOW WINES AND LIQUORS ARE PUT UP AND THE NUMBER OF GALLONS THEY CONTAIN.

Butt of Sherry	108	gallons.
Pipe of Port	115	"
Pipe of Teneriffe	100	"
Butt of Malaga	105	"
Puncheon of Scotch Whiskey	110 to 130	"
" Brandy	110 to 120	"
" Rum	100 to 110	"

Hogshead of Brandy	55 to 60 gallons.
Pipe of Madeira	92 "
Hogshead of Claret	46 "

A hogshead is one-half, a quarter cask is one-fourth, an octave is one-eighth of a pipe, butt, or puncheon.

Proportion of Alcohol in 100 parts of the following Liquors. (Brande).

Small Beer	1.08	Bordeaux	15.1
Cider	9.8	Shiraz	15.5
Porter	5.3	Malmsey	16.4
Brown Stout	6.8	Sherry	17.2
Ale	10.	" old	23.9
Perry	7.3	Alba Flora	17.3
Rhenish	7.6	Constantia, red	18.9
Moselle	8.7	Port	23.
Johannisberger	8.71	Colares	19.7
Elder Wine	8.8	Lisbon	18.9
Claret	8.9	Malaga	17.2
Tokay	9.4	Cape Muscat	18.3
Rudesheimer	10.7	Tenneriffe	19.8
Marcobrunner	11.6	Lachryma	19.7
Gooseberry Wine	11.8	Currant Wine	20.6
Frontignac	12.9	Maderia	22.3
Hockheimer	12.1	" Sercial	27.4
Vin de Grave	12.8	Marsala	25.1
Champagne	12.7	Raisin Wine	25.2
" Burgundy	14.6	Cape Madeira	29.5
Hermitage, red	12.3	Gin	51.6
" white	17.4	Brandy	53.4
Amontillado	12.6	Rum	53.7
Barsac	13.9	Irish Whiskey	53.9
Santerne	14.2	Scotch "	54.4
White Port	15.		

COMMON NAMES OF CHEMICAL SUBSTANCES.

Common Names,	Chemical Names.
Aqua Fortis	Nitric Acid.
Aqua Regia	Nitro-Muriatic Acid.
Blue Vitriol	Sulphate of Copper.
Cream of Tartar	Bitartrate of Potassium.
Calomel	Chloride of Mercury.
Chalk	Carbonate Calcium
Caustic Potassa	Hydrate Potassium.
Chloroform	Chlorlde of Gormyle.
Common Salt	" of Sodium.
Copperas, or Green Vitriol	Sulphate of Iron.
Corrosive Sublimate	Bi-Chloride of Mercury.
Diamond	Pure Carbon.

Common Names,	Chemical Names.
Dry Alum	Sulphate Aluminum and Potassium.
Epsom Salts	Sulphate of Magnesia.
Ettnops Mineral	Black Sulphide of Mercury.
Fire Damp	Light Carbureted Hydrogen.
Galena	Sulphide of Lead.
Glauber's Salt	Sulphate of Sodium.
Glucose	Grape Sugar.
Goulard Waters	Basic Acetate of Lead.
Iron Pyrites	Bi-Sulphide Iron.
Jewelers Putty	Oxide of Tin.
Kings Yellow	Sulphide of Arsenic.
Laughing Gas	Protoxide of Nitrogen.
Lime	Oxide of Calcium.
Lunar Caustic	Nitrate of Silver.
Mosaic Gold	Bi-Sulphide of Tin.
Muriate of Lime	Chloride of Calcium.
Nitre or Saltpetre	Nitrate of Potash.
Oil of Vitriol	Sulphuric Acid.
Potash	Oxide of Potassium.
Realgar	Sulphide of Arsenic.
Red Lead.	Oxide of Lead.
Rust of Iron	Oxide of Iron.
Sal-Ammoniac	Muriate of Ammonia.
Salt of Tartar	Carbonate of Potassa.
Slacked Lime	Hydrate Calcium.
Soda	Oxide of Sodium.
Spirits of Hartshorn	Ammonia.
Spirits of Salt	Hydro-Chloric or Mur'ic Acid.
Stucco or Plaster of Paris	Sulphate of Lime.
Sugar of Lead	Acetate of Lead.
Verdigris	Acetate of Copper.
Vermilion	Sulphide of Mercury.
Vinegar	Acetic Acid. (Diluted).
Volatile Alkali	Ammonia.
Water	Oxide of Hydrogen.
White Precipitate	Ammoniated Mercury.
White Vitriol	Sulphate of Zinc.

WATER AT DIFFERENT TEMPERATURES.

There are four notable temperatures for pure water, viz:—

1. Freezing point at sea level, 32° F. weight per cubic foot 62.418 pounds; per cubic inch, .03612 pounds.
2. Point of maximum density, 39. 1° F. weight per cubic foot 62.425 pounds; per cubic inch, .036125 pounds.
3. British standard for specific gravity 62° F. weight per cubic foot 62.355 pounds; per cubic inch .03608 pounds.

4. Boiling point at sea level, 212° F. weight per cubic foot 59.760 pounds; per cubic inch .03458 pounds.

Sea water, (average), has a specific gravity of 1.028, boils at 213.2° F., and weighs 64 pounds, per cubic foot at 62° F.

A British Thermal Unit (or heat unit), is that quantity of heat which will raise one pound of water at or about the freezing point, 1° Fahrenheit. A French "Caloric" is the heat required to raise one kilogramme of water 1° Centigrade, and is equal to 3.96832 British thermal units.

Herschel's Table for Foretelling the Weather.

This table and the accompanying remarks, originally formed by Dr. Herschel, and approved with some alterations, by the experienced Dr. Adam Clarke, are the result of many years' close observation, the whole being on a due consideration of the sun and moon in their several positions respecting the earth. They show what kind of weather will most probably follow the entrance of the moon into any of its quarters; so probably, indeed, that it has been seldom found to fail. If the new moon, first quarter, full moon or last quarter happens—

BETWEEN	IN SUMMER.
12 and 2, morning,	Fair
2 and 4 "	Cold, with frequent showers.
4 and 6 "	Rain.
6 and 8 "	Wind and rain.
8 and 10 "	Changeable.
10 and 12 "	Frequent showers.
12 and 2, afternoon,	Very rainy.
2 and 4 "	Changeable.
4 and 6 "	Fair.
6 and 8 "	Fair if wind N. W.; rainy
8 and 10 "	if winds S. or S. W.
10 and midnight,	Fair.

BETWEEN	IN WINTER.
12 and 2, morning,	Hard frost, unless wind be S. or W.
2 and 4 "	Snow and stormy.
4 and 6 "	Rain
6 and 8 "	Stormy.
8 and 10 "	Cold rain if wind be W.; snow if E.
10 and 12 "	Cold and high wind.
12 and 2, afternoon.	Snow or rain.
2 and 4 "	Fair and mild.
4 and 6 "	Fair.
6 and 8 "	Fair and frosty if wind N. or N. E.
8 and 10 "	rain or snow if S. or S. W.
10 and midnight.	Fair and frosty.

OBSERVATIONS.—1. The nearer the time of the moon's change, first quarter, full or last quarter is to midnight, the fairer will the weather be during the seven days following.

2. The space for this calculation occupies from 10 at night till 2 next morning.

3. The nearer to midday, or noon, the phases of the moon happen, the more foul or wet weather may be expected during the next seven days.

4. The space of this calculation occupies from 10 o'clock in the morning to 2 in the afternoon.

ALPHABETS OF DIFFERENT LANGUAGES.

The English alphabet contains 26 letters; the French, 25; Hebrew, Chaldee, and Syriac, 22; Greek, 24; Latin, 25; Spanish, 27; Italian, 20; Arabic, 28; Persian, 31; Turkish, 33; Georgian, 36; Coptic, 32; Muscovite, 43; Sclavonic, 27; Dutch, 26; Ethiopic, 222; Tartarian, 222; Bengal India, 21; Brachman, 19; Sanscrit, 28.

FACTS IN LAW.

Ignorance of the law excuses no one.

It is a fraud to conceal a fraud.

The law compels no one to do impossibilities.

An agreement without consideration is void.

Signatures made with a lead pencil are good in law.

A receipt for money paid is not legally conclusive.

The acts of one partner bind all the others.

Contracts made on Sunday cannot be enforced.

A contract made with a lunatic is void.

Contracts for advertisements in Sunday newspapers are invalid.

Principals are responsible for the acts of their agents.

Agents are responsible to their principals for errors.

Each individual in a partnership is responsible for the whole amount of the debts of the firm.

Notes bear interest only when so stated.

It is not legally necessary to say on a note "for value received."

Part payment of a debt which has passed the time of statutory limitation revives the whole debt.

An oral agreement must be proved by evidence. A written agreement proves itself. The law prefers written to oral evidence because of its precision.

RELATING TO NOTES.

Demand Notes are payable on presentation without grace, and bear legal interest, after a demand has been made, if not so written. An endorser on a demand note is holden for a limited time, variable in different States.

A Negotiable Note must be made payable either to bearer, or be properly endorsed by the person to whose

order it is made. If the endorser wishes to avoid responsibility, he can endorse "without recourse."

A Joint Note is one signed by two or more persons, who each become liable for the whole amount.

Three Days Grace are allowed on all time notes, after the time for payment expires; if not then paid, the endorser, if any, should be legally notified, to be holden.

Notes Falling Due Sunday, or on a legal holiday, must be paid the day previous.

Notes Dated Sunday are void.

Altering a Note in any manner by the holder, makes it void.

Notes Given by Minors or Lunatics are void.

The Maker of a Note that is lost or stolen is not released from payment if the amount and consideration can be proven.

Notes Obtained by Fraud, or given by an intoxicated person, cannot be collected

An Endorser has a right of action against all whose names were previously on a note endorsed by him.

Deposits of Money in a Bank placed to the credit of depositors, are always subject to their check for full amount due.

If The Letter Containing a Protest of non-payment be put into the post-office, any miscarriage does not affect the party giving notice.

READY RECKONING AND DISCOUNTS.

To Find Net Cost of a Single Article at Various Discounts.

15	per	cent.	off,	multiply	price	per dozen	by .07 1-12
20	"	"		divide	"	" "	" .15
20	and	5	"	multiply	"	" "	" .061/3
20	"	10	"	"	"	" "	" .06
25	per	cent.	"	"	"	" "	" .061/4
331/3			"	"	"	" "	" 1-18
35			"	"	"	" "	" .05 5-12
40			"	"	"	" "	" .05

40	and	5	per cent. off, multiply by	.43/4
40	"	10	" " "	.41/2
45	per	cent.	off, multiply by	.04 7-12
50	"	"	"	.04 1-6
60	"	"	"	.031/3

TABLE FOR MARKING EACH ARTICLE AT A GIVEN PER CENT. ADVANCE, WHEN BOUGHT BY THE DOZEN.

To gain	20	per	cent.,	remove point one place to left.			
"	25	"		after moving point, add			1-24
"	26	"		"	"	"	1-20
"	28	"		"	"	"	1-15
"	30	"		"	"	"	1-12
"	32	"		"	"	"	1-10
"	33⅓	"		"	"	"	1-9
"	35	"		"	"	"	⅛
"	40	"		"	"	"	1-6
"	44	"		"	"	"	1-5
"	50	"		"	"	"	¼
"	60	"		"	"	"	⅓
"	80	"		"	"	"	½

EXAMPLE 1.—If goods cost $20.00 per dozen, what is the price each, at 20 per cent. profit?

$2.00 *Answer.*

EXAMPLE 2.—At 35 per cent.

8)2.00

.25

$2.25 *Answer.*

TO FIND OUT THE DIFFERENCE BETWEEN PERCENTAGE ON AND DISCOUNT OFF A PRICE.

60 per cent. on a price, i. e. $1.00, is $1.60. This is 37½ per cent. from a price, $1.60=$1.00.

50 per cent. on a price, i. e. $1.00, is $1.50. This is 33⅓ per cent. or ⅓ from a price, $1.50=$1.00.

40 per cent. on a price, i. e. $1.00, is $1.40. This is about 28½ per cent. from a Price, $1.40=$1.01.

33 per cent. on a price. i. e. $1.00, is $1.33⅓. This is 25 per cent. from a price. $1.33⅓=$1.00.

25 per cent. on a price, i. e. $1.00 is $1.25 This is 20 per cent. or 1-5 from a price, $1.25=$1.00.

20 per cent. on a price, i. e. $1.00, is $1.20. This is 16⅔ per cent. or 1-6 from a price, $1.29=$1.00.

16⅔ per cent.on a price, i. e. $1.00 is $1.16⅔. This is about 12½ per cent. or ⅛ from a price, $1.16⅔=$1.02.

12½ per cent. on a price. i. e. $1.00, is $1.12½. This is about 10¾ per cent. from a price, $1.12½=$1.01.

10 per cent on a price, i. e. $1.00, is $1.10. This is about 9⅛ per cent. from a price, $1.10=$1.00.

To Find out the Price for Single Pieces when Gross Price is Known (this is very convenient in buying or selling articles by the piece when list price is by the gross).

Multiply gross price by 7, and point off 3 figures from the right; those remaining are cents if gross price is dollars

and will give the price very near, i. e. $10.00×7=7.000 or nearly 7¢ each, or 84¢ per dozen=$10.08 per gross.

To Make a List Price from which a Percentage can be Taken and Find Net Cost or Leave a Profit.

For cost 60 per cent. off, multiply by 10 and divide by 4.

EXAMPLE.—$1.00×10=$10.00÷4=$2.50; this less 60 per cent. i. e. $1.50=$1.00.

For profit 60 per cent. off add the profit you intend to make and proceed as above.

For 50 per cent. profit on:

EXAMPLE.—$1.00+50=$1.50×10=15.00÷4=$3.75; less 60 per cent., i. e. $2.25=$1.50.

If you want to make cost price 60 per cent. and wish to sell at 40 per cent. for retail for 50 per cent. profit on or 33⅓ per cent. off of sales:

EXAMPLE.—$2.50 list less 40 per cent.=$2.50—$1.00=$1.50 the amount of sale.

If you wish to sell at wholesale at 50 per cent. and for 25 per cent. profit on or 20 per cent. off:

EXAMPLE.—$2.50 list less 50 per cent.=$1.25, amount of sale.

For cost	50	per cent.	off,	multiply	by	10,	divide by 5
"	40	"	"	"		10	" 6
"	30	"	"	"		10	" 7
"	25	"	"	"		10	" 7½
"	20	"	"	"		10	" 8

The Following Suggestions are Given for Readily Obtaining the Cost of Goods Sold at a Discount From List Prices.

To deduct 2½ per cent., subtract 1-40 from amount.
To deduct 5 per cent., subtract 1-20 from amount.
To deduct 5 and 2½ per cent., subtract 1-20 from the amount; then 1-40 from remainder.
To deduct 7½ per cent., subtract 1½ times 5 per cent.
To deduct 10 per cent., subtract 1-10 from amount.
To deduct 10 and 5 per cent., subtract 1-10 from amount; then 1-20 from remainder.
To deduct 12½ per cent., subtract ⅛ from the amount.
To deduct 15 per cent., subtract 1½ times 10 per cent.
To deduct 15 and 5 per cent., subtract 1½ times 10 per cent. from amount, and 1-20 from remainder.
To deduct 20 per cent., subtract 1-5 from the amount.
To deduct 20 and 5 per cent., subtract 1-5 from the amount; then 1-20 from remainder.

To deduct 25 per cent., subtract ¼ from amount.

To deduct 25 and 5 per cent., subtract ¼ from the amount; then 1-20 from remainder.

To deduct 33⅓ per cent., subtract ⅓ from amount.

To deduct 35 per cent., add 30 per cent. to ½ the amount.

To deduct 40 per cent., subtract ¼ from the amount; then subtract 1-5 from remainder.

To deduct 40 and 5 per cent., subtract ¼; then subtract 1-5 from remainder; then 1-20. Or, subtract 4-10, and 1-20 from remainder.

To deduct 45 per cent., divide by 2 and add 10 per cent.

To deduct 45 and 5 per cent., divide by 2, add 1-10 and subtract 1-20.

Cost of Articles by the Piece, from 1 to 1 Dozen.

Price per Dozen.	Cost per Quantity										
	11	10	9	8	7	6	5	4	3	2	1
$1.00	$.92	$.83	$.75	$.67	$.58	$.50	$.42	$.33	$.25	$.17	$.08⅓
1.25	1.15	1.04	.94	.83	.73	.63	.52	.42	.31	.21	.10½
1.50	1.38	1.25	1.13	1.00	.88	.75	.63	.50	.38	.25	.12½
1.75	1.60	1.46	1.29	1.17	1.02	.88	.73	.56	.44	.29	.14⅝
2.00	1.83	1.67	1.50	1.33	1.17	1.00	.83	.67	.50	.33	.16⅔
2.25	2.06	1.88	1.69	1.50	1.31	1.13	.94	.75	.56	.38	.18¾
2.50	2.29	2.08	1.88	1.67	1.46	1.25	1.04	.83	.63	.42	.21⅛
2.75	2.52	2.29	2.06	1.83	1.60	1.38	1.15	.92	.69	.46	.23
3.00	2.75	2.50	2.25	2.00	1.75	1.50	1.25	1.00	.75	.50	.25
3.50	3.21	2.92	2.63	2.33	2.04	1.75	1.46	1.17	.88	.58	.29⅛
3.75	3.44	3.13	2.81	2.50	2.19	1.88	1.56	1.25	.94	.63	.31¼
4.00	3.67	3.33	3.00	2.67	2.33	2.00	1.67	1.33	1.00	.67	.33⅓
4.25	3.89	3.54	3.19	2.83	2.48	2.13	1.77	1.42	1.06	.71	.35½
4.50	4.13	3.75	3.38	3.00	2.63	2.25	1.88	1.50	1.13	.75	.37½
4.75	4.23	3.96	3.56	3.17	2.77	2.34	1.98	1.58	1.19	.79	.39⅝
5.00	4.58	4.17	3.75	3.33	2.92	2.50	2.08	1.67	1.25	.83	.41⅔
5.25	4.81	4.38	3.94	3.50	3.06	2.63	2.19	1.75	1.31	.88	.43¾
5.50	5.04	4.58	4.13	3.67	3.21	2.75	2.29	1.83	1.38	.92	.46
5.75	5.27	4.79	4.31	3.83	3.35	2.87	2.40	1.92	1.44	.96	.48
6.00	5.50	5.00	4.50	4.00	3.50	3.00	2.50	2.00	1.50	1.00	.50
6.25	5.73	5.21	4.69	4.17	3.65	3.13	2.60	2.08	1.56	1.94	.52⅛
6.50	5.96	5.42	4.88	4.33	3.79	3.25	2.71	2.17	1.63	1.08	.54¼
6.75	6.19	5.63	5.06	4.50	3.94	3.38	2.81	2.25	1.69	1.13	.56¼
7.00	6.42	5.83	5.25	4.67	4.08	3.50	2.92	2.33	1.75	1.17	.58⅓
7.25	6.65	6.04	5.44	4.93	4.23	3.63	3.02	2.42	1.81	1.21	.60½
7.50	6.88	6.25	5.63	5.00	4.38	3.75	3.13	2.50	1.88	1.25	.62½
7.75	7.11	6.46	5.81	5.17	4.52	3.88	3.23	2.58	1.94	1.29	.64⅝
8.00	7.33	6.67	6.00	5.33	4.67	4.00	3.33	2.67	2.00	1.33	.66⅔

HOW TO MARK GOODS.

Suppose an article is bought by the dozen, and the merchant wants to make 20 per cent. All he has to do is remove the decimal point one place to the left. Suppose brooms are $2.50 a dozen; then 25 cents each is the cost with 20 per cent. added. To make 25 per cent. remove the point one place to the left and add 1-24.

To	make	30	per	cent.	add	1-12	itself.
"	"	33⅓	"	"	"	1-9	"
"	"	35	"	"	"	1/8	"
"	"	40	"	"	"	1-6	"
"	"	44	"	"	"	1-5	"
"	"	50	"	"	"	1/4	"
"	"	60	"	"	"	1/3	"
"	"	80	"	"	"	1/2	"

Always remove the decimal point one place to the left before making the additions and the sum will be the selling price of the single article.

In calculating the per cent. on a single article if you wish to make

10	per	cent.	divide	by	10,	multiply by	11
20	"	"	"	"	10	" "	12
25	"	"	multiply	"	10	divide "	8
30	"	"	divide	"	10	multiply "	13
33⅓	"	"	add 1/3 of itself.				
33⅓	"	"	divide by 3			multiply by	4
50	"	"	add 1/2 of itself.				

ANTIDOTE FOR POISONS.

In cases where the other articles to be used as antidotes are not in the house, give two tablespoonfuls made mustard in a pint of warm water. Also give large draughts of warm milk or water mixed with oil, butter, or lard. If possible, give as follows:

Poisons.	*Antidotes.*
BED-BUG POISON, BLUE VITRIOL, CORROSIVE SUBLIMATE, LEAD WATER, SALTPETRE, SUGAR OF LEAD, SULPHATE OF ZINC. RED PRECIPITATE. VERMILION, BISMUTH, VERDIGRIS,	Give Milk or White of Eggs, in large quantities.

Poisons.	*Antidote.*
FOWLER'S SOLUTION, WHITE PRECIPITATE, ARSENIC,	Give prompt Emetic of Mustard and Salt, tablespoonful of each; follow with Sweet Oil, Butter, or Milk.
ANTIMONIAL WINE, TARTAR EMETIC,	Drink warm water to encourage vomiting. If vomiting does not stop, give a grain of Opium in water.
OIL VITRIOL, AQUA FORTIS, BI-CARBONATE POTASS, MURIATIC ACID, OXALIC ACID,	Magnesia or Soap, dissolved in water, every two minutes.
CAUSTIC SODA, CAUSTIC POTASH, VOLATILE ALKALI,	Drink freely of water with Vinegar or Lemon Juice in it.
CARBOLIC ACID, IODINE, IODIDE OF POTASS,	Give Flour and Water or Glutinous drinks.
CHLORAL HYDRATE, CHLOROFORM,	Pour cold water over the head and face, with artificial respiration, Galvanic Battery.
CARBONATE OF SODA, COPPERAS, COBALT,	Prompt Emetics; Soap or Mucilaginous drinks.
LAUDANUM, MORPHINE, OPIUM,	Strong Coffee followed by Ground Mustard or Grease in warm water to produce vomiting. Keep in motion.
NITRATE OF SILVER,	Give common Salt in water.
STRYCHNINE, TINCT. NUX VOMICA,	Emetic of Mustard or Sulphate of Zinc, aided by warm water.
PHOSPHORUS,	Magnesia with water and copious draughts mucilaginous drinks.

In all cases of poisoning, the first step is to evacuate the stomach. This should be effected by an emetic which is quickly obtained. Mustard or salt (tablespoonful) mixed in a tumblerful of water, or ½ teaspoonful powdered Ipecac every 10 to 15 minutes. When vomiting has already taken place, copious draughts of warm water should be given to keep up the effect till the poisonous substance has been thoroughly evacuated. If vomiting can not be produced the stomach-pump must be used.

TABLE OF UNITED STATES AND FOREIGN MONEY.

Argentine Republic.	Peso.	G	$.965
Austria.	Florin.	G	.336
Belgium	Franc.	G	.193
Bolivia.	Boliviano.	S	.68
Brazil.	Milreis.	G	.546
British Possessions, N. A.	Dollar.		1.00
Chili.	Peso.		.912
Cuba.	Peso.	G	.926
Denmark.	Crown.	G	.268
Ecudor.	Sucre.	G	.68
Egypt.	Pound (100 piastres).	G	4.943
France.	Franc.	G	.193
German Empire.	Mark.	G	.238
Great Britain.	Pound sterling.	G	4.8665
Greece.	Drachma.	G	.193
Guatemala.	Peso.	S	.68
Hayti.	Gourde.	S	.965
Honduras.	Peso.	S	.68
India.	Rupee.	G	.323
Italy.	Lira.	G	.193
Japan.	Yen.	G	.997
		S	.734
Liberia.	Dollar.		1.00
Mexico.	Dollar.	G	.739
Netherlands.	Florin.	G	.402
Nicaragua.	Peso.	S	.68
Norway.	Crown.	G	.268
Peru.	Sol.	S	.68
Portugal.	Milreis.	G	1.08
Russia.	Rouble.	G	.544
Spain.	Peseta.	G	.193
Sweden.	Crown.	G	.268
Switzerland.	Franc.	G	.193
Tripoli	Mahbub.		.614
Turkey	Piastre.	G	.044
United States Colombia.	Peso.	G	.68
Venezuela.	Bolivar.	G	.136

UNITED STATES.

10 mills (*m*)	make	1	cent	¢.
10 cents	"	1	dime	*d.*
10 dimes	"	1	dollar	$.
10 dollars	"	1	eagle	*E.*

FRANCE.

		U. S. Value.
		$. ¢. *m.*
10 Centimes equal	1 Decime.	.01.8
10 Decime "	1 Franc.	.18.7
20 Franc "	1 Napoleon (or Louis).	3.72.0
40 " "	1 Double Napoleon and (Louis).	7.44.0
5 " piece "		.93.0

GREAT BRITAIN AND IRELAND.

			U. S. Value.	$. ¢. m,
4 Farthings	equal	1 Penny		
12 Pence	"	1 Shilling.		.22,2
20 Shillings	"	1 Pound Sterling.		4.44,4
2 "	"	1 Florin.		.44,4
10 Florins	"	1 pound.		4.44,4
1 Crown	"	5 Shillings.		1.08,0
1 Sovereign	"	20 "		4.86,
1 Guinea	"	21 "		5.07,5

SPAIN.

34 Maravedis	equal	1 Real.	.11,0
8 Reals	"	1 Dollar or Plate.	.88,0
275 Maravedis	"	1 Ducat of Exchange.	2.21,0
4 Dollars of Plate	"	1 Pistole of "	3.88,4

AMSTERDAM.

16 Pfennings	equal	1 Stiver.	.02,0
20 Stivers	"	1 Florinour Guilder.	.40,0
12 Grotes, or Pence Flemish, or		1 Shilling.	.12,0
6 Stivers.		Flemish.	
20 Shillings, or	"	1 Pound.	2.40,0
6 Florins,			
21½ Florins, or	"	1 Rix Dollar.	.96,0
50 Stivers,			

HAMBURG.

12 Pfennings	equal	1 Schilling or Sol.	
16 Schillings	"	1 Mark.	.28,5
3 Marks	"	1 Rix Dollar.	.85,5

PRUSSIA.

12 Pfennings	equal	1 Silver Groschen.	.02,3
30 Groschen	"	1 Dollar.	.69,0

DENMARK.

12 Pfennings	equal	1 Skilling.	
16 Skillings	"	1 Mark	.08.7
6 Marks Danish	"	1 Rix dollar	.52,5

RUSSIA.

10 Kopecks	equal	1 Grieve	.07,5
10 Grieves	"	1 Ruble	.75,0

AUSTRIA.

4 Pfenning	equal	1 Kreutzer	
60 Kreutzers	"	1 Florin	.48,5
1½ Florins	"	1 Rix dollar	.72,7

PORTUGAL.

			U. S. Value.	$. ¢. m.
1000 Rees	equal	1 Milree.		1.24.0
400 Rees	"	1 Crusado of Exchange.		.49.6
480 Rees	"	1 New Crusado,		.59,5

ROME.

2 Mezzi Quattrini	equal	1 Quattrino.	
5 Quattrini	"	1 Baiocco.	.01.0
10 Baiocchi	"	1 Paolo.	.10.0
10 Paoli	"	1 Scudo.	1.00,6

BENGAL and CALCUTTA.

12 Pice	equal	1 Anna.	.03.3
16 Anna	"	1 Rupee.	.50,0

GREECE.

100 Lepta	equal	1 Drachma.	.16,6

TURKEY.

3 Aspers	equal	1 Para.	.01,0
40 Paras	"	1 Piastre.	.40,0

Portraits on American Currency.

$1, Washington; $2, Jefferson; $5, Jackson; $10, Webster, $20, Hamilton; $50, Franklin; $100, Lincoln; $500, General Mansfield; $1000, De Witt Clinton; $5000, Madison; $10000, Jackson. On silver certificates—$1, Martha Washington; $2, Gen. Hancock; $10, Robert Morris, Thos. A. Hendricks; $20, Commodore Decatur; $50, Edward Everett. $100, James Monroe; $500, Charles Sumner, and $1000, W. L. Marcy. On gold notes—$20, Garfield; $50, Silas Wright; $100, Thomas H. Benton; $500, A. Lincoln; $1000, Alexander Hamilton; $5000, James Madison; $10,000, Andrew Jackson.

How Birds and Animals are Grouped.

A table showing in a concise manner how various birds and animals are classed:—A covy of Partridges. A wide of Pheasants. A wisp of Snipe. A bevy of Quail. A flight of Doves or Swallows. A muster of Peacocks. A siege of Herons. A building of Rooks. A brood of Grouse. A plump of Wild Fowl. A stand of Plovers. A watch of Nightingales. A flock of Geese. A cast of Hawks. A trip of Dottrell. A swarm of Bees. A school of Whales. A shoal of Herrings. A herd of Swine. A skulk of Foxes. A pack of Wolves. A drove of Oxen. A sounder of Hogs. A troop of Monkeys. A pride of Lions. A sleuth of Bears.

Interest on $1 from 2% to 9% to thousandths of a cent, for any number of days, or months, and for 1 year.

Time.	2%	3%	4%	5%	6%	7%	8%	9%
1 da.	.00005	.00008	.00011	.00014	.00017	.00019	.00022	.00025
2	.00011	.00017	.00022	.00028	.00033	.00039	.00044	.0005
3	.00016	.00025	.00033	.00042	.0005	.00058	.00067	.00075
4	.00022	.00034	.00044	.00056	.00067	.00078	.00089	.001
5	.00028	.00042	.00056	.00069	.00083	.00097	.00111	.00125
6	.00033	.0005	.00067	.00083	.001	.00117	.00133	.0015
7	.00039	.00058	.00078	.00097	.00117	.00136	.00156	.00175
8	.00045	.00066	.00089	.00111	.00133	.00156	.00178	.002
9	.0005	.00075	.001	.00125	.0015	.00175	.002	.00225
10	.00056	.00083	.00111	.00139	.00167	.00194	.00222	.0025
11	.00061	.00091	.00122	.00153	.00183	.00214	.00244	.00275
12	.00067	.001	.00133	.00167	.002	.00233	.00267	.003
13	.00072	.00108	.00144	.00181	.00217	.00253	.00289	.00325
14	.00078	.00116	.00156	.00194	.00233	.00272	.00311	.0035
15	.00084	.00125	.00167	.00208	.0025	.00292	.00333	.00375
16	.00089	.00133	.00178	.00222	.00267	.00311	.00356	.004
17	.00095	.00141	.00189	.00236	.00283	.00331	.00378	.00425
18	.001	.0015	.002	.0025	.003	.0035	.004	.0045
19	.00106	.00158	.00211	.00264	.00317	.00369	.00422	.00475
20	.00111	.00166	.00222	.00278	.00333	.00389	.00444	.005
21	.00117	.00175	.00233	.00292	.0035	.00408	.00467	.00525
22	.00122	.00183	.00244	.00306	.00367	.00428	.00489	.0055
23	.00128	.00191	.00256	.00319	.00383	.00447	.00511	.00575
24	.00134	.002	.00267	.00333	.004	.00467	.00533	.006
25	.00139	.00208	.00278	.00347	.00417	.00486	.00556	.00625
26	.00145	.00216	.00289	.00361	.00423	.00506	.00578	.0065
27	.0015	.00225	.003	.00375	.0045	.00525	.006	.00675
28	.00156	.00233	.00311	.00389	.00467	.00544	.00622	.007
29	.00161	.00241	.00322	.00403	.00483	.00564	.00644	.00725
1 mo.	.00167	.0025	.00333	.00417	.005	.00583	.00667	.0075
2	.00334	.005	.00667	.00833	.01	.01167	.01333	.015
3	.005	.0075	.01	.0125	.015	.0175	.02	.0225
4	.00667	.01	.01333	.01667	.02	.02333	.02667	.03
5	.00834	.0125	.01667	.02083	.025	.02917	.03333	.0375
6	.01	.015	.02	.025	.03	.035	.04	.045
7	.01167	.0175	.02333	.02917	.035	.04083	.04667	.0525
8	.01334	.02	.02667	.03333	.04	.04667	.05333	.06
9	.015	.0225	.03	.0375	.045	.0525	.06	.0675
10	.01667	.025	.03333	.04167	.05	.05833	.06667	.075
11	.01834	.0275	.03667	.04583	.055	.06417	.07333	.0825
1 Yr.	.02	.03	.04	.05	.06	.07	.08	.09

EXAMPLE:—What is the Interest on $50.00 for 1 year; 3 months and 16 days at 8 per cent?

Interest on $1.00 for 1 year is . . .08000
" " 1.00 " 3 mo. " . . .02000
" " 1.00 " 16 days " . . .00356

Interest on $1.00, for 1 yr., 3 mo., 16 da.. .10356
Then $50.00 × .10356 = $5.178 interest at 8%.

Showing the Amount of $1 Improved at Compound Interest for any number of years not exceeding 50.

Yrs.	1%	1½%	2%	2½%	3%	3½%	4%	4½%	5%	6%
1	$1.01	$1.02	$1.02	$1.03	$1.03	$1.04	$1.04	$1.05	$1.05	$1.06
2	1.02	1.03	1.04	1.05	1.06	1.07	1.08	1.09	1.10	1.12
3	1.03	1.05	1.06	1.08	1.09	1.11	1.12	1.14	1.16	1.19
4	1.04	1.06	1.08	1.10	1.13	1.15	1.17	1.19	1.22	1.26
5	1.05	1.08	1.10	1.13	1.16	1.19	1.22	1.25	1.28	1.34
6	1.06	1.09	1.13	1.16	1.19	1.23	1.27	1.30	1.34	1.42
7	1.07	1.11	1.15	1.19	1.23	1.27	1.32	1.36	1.41	1.50
8	1.08	1.13	1.17	1.22	1.27	1 32	1.37	1.42	1.48	1.59
9	1.09	1.14	1.20	1.25	1.30	1.36	1.42	1.49	1.55	1.69
10	1.10	1.16	1.22	1.28	1.34	1.41	1.48	1.55	1.63	1.79
11	1.12	1.18	1.24	1.31	1.38	1.46	1.54	1.62	1.71	1.90
12	1.13	1.20	1.27	1.34	1.43	1.51	1.60	1.70	1.80	2.01
13	1.14	1.21	1.29	1.38	1.47	1.56	1.67	1.77	1.89	2.13
14	1.15	1.23	1.32	1.41	1.51	1.62	1.73	1.85	1.98	2.26
15	1.16	1.25	1.35	1.45	1.56	1.68	1.80	1.94	2.08	2.40
16	1.17	1.27	1.37	1 48	1.60	1.73	1.87	2.02	2.18	2.54
17	1.18	1.29	1.40	1.52	1.65	1.79	1.95	2.11	2.29	2.69
18	1.20	1.31	1.43	1.56	1.70	1.86	2.03	2.21	2,41	2.85
19	1.21	1.33	1.46	1.60	1.75	1.92	2.11	2.31	2.53	3.03
20	1.22	1.35	1.49	1.64	1.81	1.99	2.19	2.41	2.65	3.21
21	1.23	1.37	1.52	1.68	1.86	2.06	2.28	2.52	2.79	3.40
22	1.24	1.39	1.55	1.72	1.92	2.13	2.37	2.63	2.93	3.60
23	1.26	1.41	1.58	1.76	1.97	2.21	2.46	2.75	3.07	3.82
24	1.27	1.43	1.61	1.81	2.03	2.28	2.56	2.88	3.23	4.05
25	1.28	1.45	1.64	1.85	2.09	2.36	2.67	3.01	3.39	4.29
26	1.30	1.47	1.67	1.90	2.16	2.45	2.77	3.14	3.56	4.55
27	1.31	1.49	1.71	1.95	2.22	2.53	2.88	3.28	3.73	4.82
28	1.32	1.52	1.74	2.00	2.29	2.62	3.00	3.43	3.92	5.11
29	1.33	1.54	1.78	2.05	2.36	2.71	3.12	3.58	4.12	5.42
30	1.35	1.56	1.81	2.10	2.43	2.81	3.24	3.75	4.32	5.74
31	1.36	1.59	1.85	2.15	2.50	2.91	3.37	3.91	4.54	6.09
32	1.37	1.61	1.88	2.20	2.58	3.01	3.51	4.09	4.76	6.45
33	1.39	1.63	1.92	2.26	2.65	3.11	3.65	4.27	5.00	6.84
34	1.40	1.66	1.96	2.32	2.73	3.22	3.79	4.47	5 25	7.25
35	1.42	1.68	2.00	2,37	2.81	3.33	3.95	4.67	5.52	7.69
36	1.43	1.71	2.04	2.43	2.90	3.45	4.10	4.88	5.79	8.15
37	1.45	1.73	2.08	2.49	2.99	3.57	4.27	5.10	6.08	8.64
38	1.46	1.76	2.12	2.56	3.07	3.70	4.44	5.33	6.39	9.15
39	1.47	1.79	2.16	2.62	3.17	3.83	4.62	5.57	6.70	9.70
40	1.49	1.81	2.21	2.69	3.26	3.96	4.80	5.82	7.04	10.29
41	1.50	1.84	2.25	2.75	3.36	4.10	4.99	6.08	7.39	10.90
42	1.52	1.87	2.30	2.82	3.46	4.24	5.19	6.35	7.76	11.56
43	1.53	1.90	2.34	2.89	3.56	4.39	5.40	6.64	8.15	12.25
44	1.55	1.93	2.39	2.96	3.67	4.54	5.62	6.94	8.56	12.99
45	1.56	1.95	2.44	3.04	3.78	4.70	5.84	7.25	8.99	13.76
46	1.58	1.98	2.49	3.11	3.90	4.87	6.08	7.57	9.43	14.50
47	1.60	2.01	2.54	3.19	4.01	5.04	6.32	7.92	9.91	15.47
48	1.61	2.04	2.59	3.27	4.13	5.21	6.57	8.27	10.40	16.39
49	1.63	2.07	2.64	3.35	4.26	5.40	6.88	8.64	10.92	17.38
50	1.64	2.11	2.69	3.44	4.38	5.58	7.11	9.03	11.47	18.42

TABLE showing the net amount of earnings of ONE CENT to FIFTY DOLLARS *per day* for FIVE YEARS of 313 working days, without interest and with interest at 5, 6, 7, and 8, per cent., improved each *six months*.

Savings per day.	Without interest.	With interest at 5%	With interest at 6%	With interest at 7%	With interest at 8%
1	$15 65	$17 53	$17 94	$18 36	$18 79
2	31 30	35 07	35 88	36 72	37 58
3	46 95	52 60	53 82	55 08	56 37
4	62 60	70 13	71 76	73 44	75 16
5	78 25	87 67	89 70	91 80	93 95
6	93 90	105 20	107 65	110 16	112 74
7	109 55	122 73	125 59	128 52	131 53
8	125 20	140 27	143 53	146 88	150 32
9	140 85	157 80	161 47	165 24	169 11
10	156 50	175 33	179 41	183 60	187 90
15	234 75	263 00	267 11	275 39	281 84
20	313 00	350 00	358 82	367 19	375 79
25	391 25	438 33	448 52	458 99	469 74
30	469 50	526 00	538 23	550 79	563 69
40	626 00	701 33	717 64	734 39	751 58
50	782 50	876 66	897 03	917 98	939 48
60	939 00	1,052 00	1,076 46	1,101 58	1,127 37
70	1,095 50	1,227 33	1,255 87	1,285 17	1,315 27
80	1,202 00	1,402 66	1,435 28	1,468 77	1,503 16
90	1,408 50	1,578 00	1,614 69	1,652 37	1,691 06
$1 00	1,565 00	1,753 33	1,794 10	1,835 96	1,878 96
2 00	3,130 00	3,506 66	3,588 19	3,671 93	3,757 91
3 00	4,695 00	5,259 99	5,382 29	5,507 89	5,636 87
4 00	6,260 00	7,013 32	7,176 39	7,343 85	7,515 82
5 00	7,825 00	8,766 65	8,970 49	9,179 82	9,394 78
6 00	9,390 00	10,519 98	10,764 58	11,015 78	11,273 73
7 00	10,955 00	12,273 30	12,558 68	12,851 74	13,132 69
8 00	12,520 00	14,027 63	14,352 78	14,688 70	15,031 65
9 00	14,085 00	15,779 95	16,146 87	16,523 67	16,910 60
10 00	15,650 00	17,533 29	17,940 96	18,359 63	18,789 56
15 00	23,475 00	26,299 94	26,711 46	27,539 45	28,184 34
20 00	31,300 00	35,066 58	35,881 94	36,719 26	37,579 12
25 00	39,125 00	43,833 23	44,852 43	45,899 08	46,973 89
30 00	46,950 00	52,599 88	53,822 91	55,078 89	56,368 67
35 00	54,775 00	61,366 52	62,793 40	64,258 71	65,763 45
40 00	62,600 00	70,133 17	71,763 88	73,438 52	75,158 23
45 00	70,425 00	78,899 82	80,734 37	82,618 34	84,533 01
50 00	78,250 00	87,666 46	89,704 86	91,798 15	93,947 79

Time at which Money Doubles at Compound Interest.

At 10 per cent interest, in 7 years 3½ months; at 9 per cent., in 8 years ½ month; at 8 per cent., in 9 years; at 7 per cent., in 10 years 3 months; at 6 per cent., in 11 years 11 months; at 5 per cent., in 14 years 2½ months; at 4 per cent., in 17 years 8 months; at 3 per cent., in 23 years 5½ months; at 2 per cent., in 35 years.

Handy Interest Rules.

For finding the interest on any principal for any number of days, multiply in each case the dollars by the number of days, and for ascertaining at the rate of—

3	per cent.,	Divide by 120	9	per cent.,	Divide by 40
4	"	" 90	10	"	" 36
5	"	" 72	12	"	" 30
6	"	" 60	15	"	" 24
7	"	" 52	18	"	" 20
8	"	" 45	20	"	" 18

Then by cutting off the two right hand figures, you have the interest in dollars and cents.

Example:—Interest on $50 for 30 days at 4 per cent., 50×30 equals 15.00, which divided by 90 equals 16⅔, the required result.

Calculating Interest.

To find the interest on any given amount for a given time:

For 1 per cent., multiply the amount by the number of days and divide by 36,000.

For 2 per cent., multiply the amount by the number of days and divide by 18,000.

For 3 per cent., multiply the amount by the number of days and divide by 12,000.

For 4 per cent., multiply the amount by the number of days and divide by 9,000.

For 5 per cent., multiply the amount by the number of days and divide by 7,200.

For 6 per cent., multiply the amount by the number of days and divde by 6,000.

For 7 per cent., multiply the amount by the number of days and divide by 6,000 and add $\frac{1}{6}$.

For 8 per cent., multiply the amount by the number of days and divide by 4,500.

For 9 per cent., multiply the amount by the number of days and divide by 4,000.

For 10 per cent., multiply the amount by the number of days and divide by 3,600.

For 11 per cent., multiply the amount by the number of days and divide by 3,600 and add $\frac{1}{10}$.

For 12 per cent., multiply the amount by the number of days and divide by 3,000.

For 13 per cent., multiply the amount by the number of days and divide by 3,000 and add $\frac{1}{12}$.

For 14 per cent., multiply the amount by the number of days and divide by 3,000 and add $\frac{1}{6}$.

For 15 per cent., multiply the amount by the number of days and divide by 2,400.

The formula is as follows:

$$\text{Principal} \times \text{number of days} \div \frac{36{,}000}{\text{Rate \%}} = \text{interest.}$$

Table showing the number of days from any given day in one month to any given day in another month.

Mo.	Ja.	Fe.	M.	Ap.	Ma.	Ju.	J'y.	Au.	Se.	Oc.	No.	De.
Jan.	365	31	59	90	120	151	181	212	243	273	304	334
Feb.	334	365	28	59	89	120	150	181	212	242	273	303
Mar.	306	337	365	31	61	92	122	153	184	214	245	275
Apr.	275	306	334	365	30	61	91	122	153	183	214	244
May.	245	276	304	335	365	31	61	92	123	153	184	214
Jun.	214	245	273	304	334	365	30	61	92	122	153	183
Jul.	184	215	243	274	304	335	365	31	62	92	123	153
Aug.	153	184	212	243	273	304	334	365	31	61	92	122
Sep.	122	153	181	212	242	273	303	334	365	30	61	91
Oct.	92	123	151	182	212	243	273	304	335	365	31	61
Nov.	61	92	120	151	181	212	242	273	304	334	365	30
Dec.	31	62	90	121	151	182	212	243	274	304	335	365

RULE:—Find the first given month in the left hand column, and the second given month in the line at the top of the table, and to the number of days found at the intersection of the two lines, add the difference between the days mentioned in the two given months.

When the number of days given in the first mentioned month is greater than the given number of days in the second month, then the difference of the days must be subtracted.

EXAMPLE:—How many days from March 21st to the 23rd of next September.

184, the number of days at intersection of the lines, and 23 − 21 = 2. the difference of the days in the two given months. Hence 184 + 2 = 186 days.

When February has 29 days, proper allowance must be made.

INTEREST LAWS OF DIFFERENT STATES.

In the subjoined table the figures under the head "Legal" show the legal rate per cent.; those under "Special" show the *highest rate allowed under special contract;*

STATE.	Legal.	Special.	Penalty of Usury.
Alabama	8	.....	Loss of interest.
Arizona	10	‡	None.
Arkansas	6	‡	None.
California	.....	‡	None.
Colorado	.....	‡	None.
Connecticut	7	‡	Forfeiture of all interest.
Dakota	7	18	Forfeiture of contract.
Delaware	6	6	Forfeiture of contract.
District of Columbia	6	10	Forfeiture of all interest.
Florida	8	‡	None.
Georgia	7	7	None.
Idaho	10	24	$300, or impisonment 6 months, or both.
Illinois	6	10	Forfeiture of all the interest.
Indiana	6	10	Forfeiture of interest and costs.
Iowa	6	10	Forfeiture of excess.
Kansas	7	12	Forfeiture of excess over 12 per cent.
Kentucky	6	10	Forfeiture of all the interest.
Louisiana	5	8	Forfeiture of interest.
Maine	6	‡	Forfeiture of excess.
Maryland	6	6	Forfeiture of excess.

INTEREST LAWS OF DIFFERENT STATES (CONTINUED).

Massachusetts	6	‡	None (6 per cent. on judgments).
Michigan	6	10	Forfeiture of excess.
Minnesota	7	12	Forfeiture of excess over 7 per cent.
Mississippi	6	‡	None.
Missouri	6	10	Forfeiture of all interest.
Montana	10	.....	None.
Nebraska	10	12	Forfeiture of all interest and costs.
Nevada	10	‡	None.
New Hampshire	6	6	Forfeiture of three times the interest received.
New Jersey	7	7	Forfeiture of all interest.
New Mexico	6	12	None.
New York	6	6	Forfeiture of contract.
North Carolina	6	8	Forfeiture of interest.
Ohio	6	8	Forfeiture of excess.
Oregon	10	12	Forfeiture of interest, principal and costs.
Pennsylvania	6	6	Forfeiture of excess, Act May 28, 1858.
Rhode Island	*6	‡	Forfeiture, unless a greater rate is contracted.
South Carolina	7	‡	None.
Tennessee	6	10	Forfeiture of excess over 6 per cent. and $100 fine.
Texas	8	‡	None.
Utah	10	‡	None.
Vermont	6	†7	Forfeiture of excess.
Virginia	6	12	Forfeiture of contract.
Washington Territory	10	‡	None.
West Virginia	6	6	Forfeiture of excess.
Wisconsin	7	10	Forfeiture of all the interest.
Wyoming	10	‡	None.

*Rate on judgments unless otherwise expressed. † On railroad bonds only. ‡ No limit.

Statutes of Limitations—State Laws with reference to Limitation of Action, the limit of years to bring Action.

STATES and TERRITORIES.	*Assault. Replevin etc.*	*Open accnts.*	*Notes.*	*Judgments.*	*Sealed & witnes'd Instr'ts.*
Alabama	1	3	6	20	10
Arkansas	1	3	5	10	10
California	3	2	4	5	5
Colorado	1	2	2	3	3
Connecticut	1	6	6	6	17
Dakota	2	6	6	20	20
Delaware	1	3	6	20	20
District of Columbia	1	3	3	12	12
Florida	2	5	5	20	20
Georgia	1	4	6	7	20
Idaho	3	2	4	5	5
Illinois	1	5	10	20	10
Indiana	2	6	20	20	20
Iowa	2	5	10	20	10
Kansas	1	3	5	5	15
Kentucky	1	5	5	15	15
Louisiana	1	3	5	10	20
Maine	2	6	20	20	20
Maryland	3	3	3	12	12
Massachusetts	2	6	20	20	20
Michigan	2	6	6	10	10
Minnesota	2	6	6	10	20
Mississippi	1	3	6	7	7
Missouri	1	4	20	5	10
Montana	2	2	4	5	4
Nebraska	2	6	20	20	10
Nevada	2,6	6	20	20	20
New Hampshire	1	–	—	10	10
New Jersey	2	6	6	20	20
New Mexico	1	3	10	10	10
New York	1	6	15	15	15
North Carolina	1	3	10	10	10
Ohio	1	6	15	15	15
Ontario (U. Canada)	1	5	5	30	30
Oregon	2	1	6	10	20
Pennsylvania	1	6	6	20	20
Quebec (L. Canada)	1.2	5	5	30	30
Rhode Island	1	6	6	20	20
South Carolina	2	6	6	20	20
Tennessee	1	6	6	20	—
Texas	1	2	4	10	10
Utah	1	2	4	5	7
Vermont	2	6	14	8	8
Virginia	5	5	5	10	20
Washington Territory	2	3	6	9	20
West Virginia	5	5	6	10	10
Wisconsin	2	6	6	20	20
Wyoming	1	6	15	10	21

EXEMPTION LAWS OF UNITED STATES.

STATES.	Value of Personal Property.	Acres of Land.	Value of Homestead.
Alabama	$1,000	160	$2,000
Arizona	900		5,000
Arkansas	500	160	2,500
California	900		5,000
Colorado	1,000	§	2,000
Connecticut	500		*
Dakota	1,500	160	*
Delaware	200		*
District of Columbia	300		*
Florida	1,000	160	
Georgia	300	50	1,600
Idaho	300		5,000
Illinois	300		1,000
Indiana	600		*
Iowa	200	40	‖
Kansas	800	160	
Kentucky	200		1,000
Louisiana	†	160	†
Maine	300		500
Maryland	100		*
Massachusetts	450		800
Michigan	400	40	1,500
Minnesota	800	80	
Mississippi	550	80	2,000
Missouri	300	160	1,500
Montana	900		5,000
Nebraska	.....	160	2,000
Nevada	900		5,000
New Hampshire	450		500
New Jersey	200		1,000
New Mexico	900		5,000
New York	250		1,000
North Carolina	500		1,000
Ohio	100		1,000
Oregon	175		*
Pennsylvania	300		*
Rhode Island	500		*
South Carolina	500		1,000
Tennessee	1,200		1,000
Texas	.....	200	5,000
Utah	.....		1,000
Vermont	200		500
Virginia	.....		
Washington	‡	‡	‡
West Virginia	200		1,000
Wisconsin	450	40	
Wyoming	900		5,000

* No Homestead Law. † The homestead, land and personal property not to exceed $2,000. ‡ Similar to California. § Any number. ‖ No limit.

Rules of Parliamentary Procedure.

Trace each motion to its respective references on the next page, and you master at a glance the intricacies of Parliamentary usages, comprising some three hundred points of order:

Motion to adjourn	1 a * B *a* J x
Motion to determine time to which to adjourn	2 a † A *a* J x
Motion to amend	3 a † A *a* J x
Motion to amend an amendment	3 a * A *a* J x
Motion to amend the rules	3 a † A *b* J x
Motion to appeal from Speaker's decision *re* indecorum	1 a † A *a* J n
Motion to appeal from Speaker's decision generally	3 a * A *a* J n
Call to order	1 a * A *a* S n
Motion to close debate on question	1 a † A *b* J x
Motion to commit	3 b † A *a* J x
Motion to extend limits of debate on question	1 a † A *a* J x
Leave to continue speaking after indecorum	1 a * A *a* J x
Motion that ... do lie on the table	1 a * C *a* J x
Motion to limit debate on question	1 a † A *b* J x
Objection to consideration of question	1 a * A *b* S n
Motion for the orders of the day	1 a * A *a* S n
Motion to postpone to a definite time	4 a † A *a* J x
Motion to postpone indefinitely	3 *b* * A *a* J x
Motion for previous question	1 a * A *b* J x
Questions touching priority of business	1 a † A *a* J x
Questions of privilege	3 a † A *a* J x
Reading papers	1 a * A *a* J x
Motion to reconsider a debatable question.	3 b * B *a* J z
Motion to reconsider an undebatable question	1 a * B *a* J z
Motion to refer a question	3 b † A *a* J x
Motion that committee do not rise	1 a * B *a* J x
Question whether subject shall be discussed	1 a * A *b* S n
Motion to make subject a special order	3 a † A *b* J x
To substitute in the nature of an amendment	3 a † A *a* J x
Motion to suspend the rules	1 a * B *b* J x
Motion to take from the table	1 a * C *a* J x
To take up question out of its proper order	1 a * A *b* J x
Motion to withdraw a motion	1 a * A *a* J x
Questions of precedence of questions	5 6 7 8 9 10 12
Forms in which questions may be put	13 14 15 16 17 18 19

RULES OF PARLIAMENTARY PROCEDURE—*Condensed.*

1. Question undebatable: sometimes remarks tacitly allowed.
2. Undebatable if another question is before the assembly.
3. Debatable question.
4. Limited debate only on propriety of postponement.
a. Does not allow reference to main question.
b. Opens the main question to debate.
*. Cannot be amended.
†. May be amended.
A. Can be reconsidered.
B. Cannot be reconsidered.
C. An affirmative vote on this question cannot be reconsidered.
b. Requires two-third vote unless special rules have been enacted.
a. Simple majority suffices to determine the question.
J. Motion must be seconded.
S. Does not require to be seconded.
x. Not in order when another has the floor.
n. Always in order though another may have the floor.
z. May be moved and entered on the record when another has the floor, but the business then before the assembly may not be put aside. The motion must be made by one who voted with the prevailing side, and on the same day the original vote was taken.
5. Fixing the time to which an adjournment may be made; ranks first.
6. To adjourn wihout limitation; second.
7. Motion for the Orders of the Day; third.
8. Motion that .. do lie on the table; fourth.
9. Motion for the previous question; fifth.
10. Motion to postpone definitely; sixth.
12. Motion to commit; seventh.
13. Motion to amend; eighth.
14. Motion to postpone indefinitely; ninth.
15. On motion to strike out words, "Shall the words stand part of the motion?" unless a majority sustains the words they are struck out.
16. On motion for previous question the form to be observed is, "Shall the main question be now put?" This, if carried, ends debate.
17. On an appeal from the Chair's decision, "Shall the decision be sustained as the ruling of the house?" The chair is generally sustainded.
18. On motion for Orders of the Day, "Will the house now proceed to the Orders of the Day?" This, if carried, supersedes intervening motions.
19. When an objection is raised to considering question, "Shall the question be considered?" objection may be made by any member before debate has commenced, but not subsequently.

Law of Grace on Sight Drafts, and Damages on Protested Bills of Exchange.

STATES.	*ON SIGHT DRAFTS.*
Alabama	Grace is allowed.
Arizona	Grace allowed.
Arkansas	No statute.
California	No grace.
Colorado	No grace.
Connecticut	No grace.
Dakota	Allowed by statute of 1873.
Delaware	No grace.
District of Columbia	No grace.
Florida	No grace by custom.
Georgia	No grace. Act Feb. 8, 1850.
Idaho	No grace.
Illinois	No grace.
Indiana	Grace allowed.
Iowa	Grace allowed.
Kansas	Grace allowed.
Kentucky	Grace allowed.
Louisiana	Grace not allowed by custom.
Maine	Grace allowed. Rev. St'ts., p. 264.
Maryland	Grace not allowed.
Massachusetts	Grace allowed.
Michigan	Grace allowed by custom.
Minnesota	Grace allowed by custom.
Mississippi	Grace allowed by custom.
Missouri	Grace not allowed by custom.
Montana	Grace allowed by custom.
Nebraska	Grace allowed by statute.
Nevada	Grace not allowed.
New Hampshire	Grace allowed by Rev. St'ts p 389.
New Jersey	Grace allowed by statute.
New Mexico	Grace allowed.
New York	Grace not allowed. Act Ap'l, 1857.
North Carolina	Grace allowed. Act Jan'y, 1849.
Ohio	Grace not allowed. Act Feb. 1861.
Oregon	Grace allowed by statute.
Pennsylvania	Grace not allowed. Act May 1857.
Rhode Island	Grace not allowed. Act May 1857.
South Carolina	Grace allowed. Act 1848.
Tennessee	Grace not allowed by statute.
Texas	Grace not allowed by usage.
Utah	Grace allowed by custom.
Vermont	Grace not all'ed. St'te Jan. 1873.
Virginia	Grace not allowed by statute 1873.
Washington	No Grace.
West Virginia	No grace by custom.
Wisconsin	Grace all'ed. Rev. statutes, 1849.
Wyoming	Grace allowed by custom.
Canada	Grace allowed by custom.

The damages on a domestic Bill of Exchange or note, consist of Notaries' fees, postage, &c., and range from $1.25 to $2.50, according to the Statute of the State where it goes to protest. Foreign Bills, that is, drafts drawn by a person out of the United States upon another within the same, or the reverse, and protested for non-payment, are subject to a total expense for protest, &c., of from $1.50 upwards.

WEIGHTS AND MEASURES.

Avoirdupois Weight.

16 drachms	equal	1 ounce.
16 ounces	"	1 pound.
25 pounds	"	1 quarter.
4 quarters	"	1 hundred.
20 hundred	"	1 ton

The English quarter is 28 lbs. Hundred weight 112 lbs. Ton 2240 pounds.

Troy Weight.

24 grains	equal	1 pennyweight.
20 pennyweight	"	1 ounce.
12 ounces	"	1 pound.

Weighing Diamonds 3⅓ grains equal one carat.

The standard unit of weight (the Troy lb.) is equal to 22.794422 inches of distilled water, at the temperature of 39.83°, the barometer being at 30 inches. This is the unit measure of weight, (in the U. S. Mint).

7000 Troy grains	equal	1 lb.	avoirdupois.
175 " pounds	"	144 lb.	"
175 " ounces	"	192 oz.	"
4371½ " grains	"	1 oz.	"

Apothecaries Weight.

20 grains (*gr*)	equal	1 scruple, or ℈
3 scruples	"	1 dram, or ʒ
8 drams	"	1 ounce, or ℥
12 ounces	"	1 pound, lb or ℔.

Apothecaries Fluid Measure.

60 minims (or drops)	equal	1 fluid dram fl ʒ.
8 fluid drams	"	1 " ounce fl ℥.
16 " ounces	"	1 pint.
8 pints	"	1 gallon.

45 drops, or a common teaspoonful, make about 1 fluid dram; 2 teaspoonfuls about 1 fluid-ounce; a wineglassful about 1½ fluid-ounces; and a teacupful about 4 fluid-ounces.

LIQUID OR WINE MEASURE.

4 gills	equal	1 pint.
2 pints	"	1 quart.
4 quarts	"	1 gallon.
31½ gallons	"	1 barrel.
42 gallons	"	1 tierce.
63 gallons	"	1 hogshead,
2 tierces	"	1 puncheon.
2 hogsheads	"	1 pipe or butt,
2 pipes	"	1 tun.

The following cylinders contain some of these measures very closely.

	Diameter.	Height.		Diameter.	Height.
Gill	1¾ inches.	3 ins.	1 Gallon	7 inches.	6 ins.
½ Pint	2¼ "	3⅝ "	2 "	7 "	12 "
Pint	3½ "	3 "	8 "	14 "	12 "
Quart	3½ "	6 "	10 "	14 "	15 "

The *Standard Unit of Liquid Measure* adopted by the U. S. Government is the *Winchester Wine Gallon*, which contains 231 cubic inches, and holds 8.339 lbs. Avoirdupois of distilled water, at its maximum density weighed in air, the barometer being at 30 inches.

The *Imperial Gallon* adopted by Great Britain contains 277.274 cubic inches, containing 10 lbs. Avoirdupois of distilled water, weighed in air, at a temperature of 62°, the barometer at 30 inches and equals 1.20032 U. S. gallons.

To convert Imperial gallons to U. S. gallons multiply by 1.20032. And to convert U. S. gallons to Imperial gallons multiply by .83311.

UNITED STATES AND BRITISH LINEAL MEASURE.

The *Standard Unit* of the U. S. and British linear measure is the yard. It was intended to be exactly the same for both countries, but in reality the U. S. yard exceeds the British Standard by .00087 inch. The *actual Standard of length* of the U. S. is a brass scale 82 inches long prepared for the Coast Survey and deposited in the office of Weights and Measures at the U. S. Treasury Department Washington. The yard is between the 27th and 63rd inches of this scale. The *temperature* at which this scale is designed to be standard and at which it is used in the U. S. Coast Survey, is 62° Fahrenheit.

The Imperial (British) standard yard is referred to a natural standard, which is the length of a pendulum vi-

brating seconds in vacuo in London, at the level of the sea; measured on a brass rod, at a temperature of 62°.

Long Measure.

12 inches	equal	1 foot.
3 feet	"	1 yard.
5½ y'ds or 16½ ft.	"	1 rod.
40 rods	"	1 furlong.
8 furlongs	"	1 mile.

One yard is .000568 of a mile. One inch is .0000158 of a mile.

Square Measure.

144 square inches	equal	1 sq. foot.
9 " feet	"	1 sq. yard.
30¼ " yards	"	1 sq. rod.
40 " rods	"	1 rood.
4 roods	"	1 acre.
640 acres	"	1 sq. mile.

An acre is 63.5701 yards square; or 208.710321 feet square; 220 feet by 198 feet square equal 1 acre.

Surveyor's Measure.

7.92 inches	equal	1 link.
25 links	"	1 rod.
4 rods	"	1 chain (66 ft).
80 chains	"	1 mile.

A Nautical mile contains 6080 feet. A Statute mile 5280 feet. Three Nautical miles 1 league; 20 leagues 1 degree; 6 feet 1 fathom. One knot or geographical mile is 1-60 of a degree; 3 knots make 1 marine league; 60 knots or 69.19 statute miles equal 1 degree. A hair's breadth is 1-48 part of an inch. A ship's cable is a chain usually about 120 (720 ft.) fathoms long.

Dry Measure.

2 pints	equal	1 quart.
4 quarts	"	1 gallon.
2 gallons	"	1 peck.
4 pecks	"	1 bushel.

The standard bushel is the Winchester, containing 2150.42 cubic inches, or 77.627 avoirdupois pounds of distilled water at its maximum density. Its diameter (cylinder) inside is 18½ inches, outside 19½ inches, its depth is 8 inches.

The Imperial (English) bushel equals 2218.192 cubic inches, equals 1.03152 U. S. bushels.

36 U. S. bushels equals 1 chaldron equals 58.658 cubic feet and weighs 3,136 pounds.

Heaped bushel, 19½ inches in diameter, cone 6 inches equals 2815.4872 cubic inches.

32 British or Imperial bushels are equal to 38 U. S. bushels. The English quarter equals 8¼ (nearly) U. S. bushels and contains 10.2694 cubic feet. Four quarts or ½ peck equals 282 cubic inches.

Solid or Cubic Measure.

1728 cubic inches	equal	1 cubic foot.
27 " feet	"	1 " yard.
128 " feet	"	1 cord.

8 feet long, 4 feet wide, 4 feet high, equal 128 cubic feet or 1 cord of wood. 24¾ cubic feet equal 1 perch of stone, or masonry. One cubic foot of water weighs 62½ pounds. A cubic foot contains 2200 cylindrical inches, 3300 spherical inches, or 6600 conical inches.

Cloth Measure.

2¼ inches	equal	1 nail.
4 nails	"	1 quarter.
4 quarters	"	1 yard.
3 "	"	1 ell Flemish.
5 "	"	1 ell English.
6 "	"	1 ell French.
4 2-15 "	"	1 ell Scotch.

Metric, or French Liquid and Dry Measure.

	Litres.	*U. S. Cu. Ins.*	*U. S.*
Millilitre	equal .001	equal .061	= { Liquid .00845 gill. Dry .0018 pint.
Centilitre	equal .01	equal .61	= { Liquid .0845 gill. Dry .018 pint.
Decilitre	equal .1	equal 6.1	= { Liquid .845 gill. Dry .18 pint.
Litre	equal 1.	equal 61.02	= { Liquid 2.113 pints. Dry 1.8 "
Decalitre	equal 10.	equal 610.16	= { Liquid 2.641 galls. Dry 2.27 "

	U. S. Cu. Ft.	
Hectolitre	equal 100.	equal 3.531 = { Liquid 26.414 galls. Dry 2.837 bush.
Kilolitre	equal 1000.	equal 35.31 = { Liquid 264.141 gals. Dry 28.374 bush.
Myrialitre	equal 10000.	equal 353.1 = { Liquid 2641.4 gals. Dry 283.7 bush.

Metric, or French Lineal Measure.

		Metres.		*U. S. Measure.*
Mynametre	equal	10,000.	equal	6.2137 miles.
Kilometre	"	1,000.	"	.62137 "
Hectometre	"	100.	"	328.1 feet.
Decametre	"	10.	"	393 7 inches.
Metre	"	1.	"	39.37 "
Decimetre	"	.1	"	3.937 "
Centimetre	"	.01	"	.3937 "
Millimetre	"	.001	"	.03937 "

Metric, or French Square Measure.

	Sq. Metres.		*U. S. Sq. Measure.*
Sq. Centimetre	equal .01	equal	.155 sq. inches.
Sq. Decimetre	" .1	"	1.55 sq. "
Centiare	" 1.	"	10.763 sq. feet.
Are	" 10.	"	119.6 sq. yards.
Hectare	" 100.	"	2.47 Acres.

Sq. Kilometre equal .38607 sq. miles equal 247 acres.
Sq. Mynametre equal 38.607 sq. miles equal 24708 acres.

Metric, or French Cubic or Solid Measure.

	Cu. Metres.		*U. S. Cu. Measure.*
Cubic Centimetre	equal .0001	equal	6.10165 cu. inches.
" Decimetre	" .001	"	61.0165 cu. "
Centistere	" .01	"	.353105 cu. feet.
Decistere	" .1	"	3.53105 cu. "
Stere	" 1.	"	1.3078 cu. yards.
Decastere	" 10.	"	13.078 cu. "
Hectostere	" 100.	"	130.78 cu. "

Metric, or French Weights.

	Grammes.		*Avoir.*
Millegramme	= .001	=	.00003528 ounce.
Centigramme	= .01	=	.0003528 "
Decigramme	= .1	=	.003528 "
Gramme	= 1.	=	.03528 "
Decagramme	= 10.	=	.3528 "
Hectogramme	= 100.	=	3.52758 "
Kilogramme	= 1,000.	=	35.2758 "
Myriogramme	= 10,000.	=	22.04737 pounds.
Quintal	= 100,000.	=	220.4737 "
Tonneau	=1,000,000.	=	2204.737 "

THE FRENCH METRE.

The French metre is intended to be the one ten-millionth part of the distance from either pole of the earth to the equator; but after it had been introduced into use, errors were discovered in the calculations employed for ascertaining that distance; so that the French metre, like the British standard yard, is not what it was intended to be. By the British standard, the length of the metre is, approximately, 1.093633 yard; or 3.280899 feet; or 39.37079 inches. By the U. S. standard it is, very approximately, 1.0935697 yard; or 3.280709 feet; or 39.368505 inches.

The unit of Length is the *Metre*. The unit of Weight is the *Gram*. The unit of Capacity is the *Liter*. The unit of Area is the *Are*. A Cubic Metre is called *Stere*.

The higher denominations are expressed by prefixing to the unit, the Greek words: *Deca* (10), *Hecto* (100), and *Kilo* (1000). Thus, a decametre = 10 Metres; a hectoliter = 100 Liters; a kilogram = 1000 Grammes.

The lower denominations are expressed by prefixing the Latin words: *Deci* (10), *Centi* (100), *Milli* (1000). Thus, a decigram is the 10th part of a Gram; a centimetre is the 100th part of a Metre, etc.

COMMON MEASURES AND WEIGHTS, WITH THEIR METRIC EQUIVALENTS.

Common Measure.	*Equivalents.*	
An inch	2.54	Centimetres.
A foot	.3048	Metres.
A yard	.9144	"
A rod	5.029	"
A mile	1.6093	Kilometres.
A square inch	6.452	Sq. Centimetres.
A square foot	.0929	Sq. Metres.
A square yard	.8361	Sq. "
A square rod	25.29	Sq. "
An acre	.4047	Hectare.
A Square mile	259.008	Hectares.
A cubic inch	16.39	Cu. Centimetres.
A cubic foot	.02832	Cu. Metre.
A cubic yard	.7646	Cu. "
A cord	3.624	Steres.
A liquid quart	.9465	Liter.
A gallon	3.786	Liters.
A dry quart	1.101	"
A peck	8.811	"
A bushel	35.24	"
An ounce Avoir.	28.35	Grams.
A pound "	.4536	Kilogram.
A ton "	.9072	Tonneau.
A grain Troy	.0648	Gram.
An oz; "	31.104	Grams.
A lb., "	.3732	Kilogram.

WAGES TABLE—YEARLY, MONTHLY, WEEKLY AND DAILY—TEN HOURS TO THE DAY.

Wages Per Year.	Wages Per Month.	Wages Per Week.	Wages Per Day.	Wages Per Year.	Wages Per Month.	Wages Per Week.	Wages Per Day.
$1000 is	$83.33	$19.23	$2.74	$295 is	$24 58	$5.67	81c.
975	81 25	18.75	2 67	290	24.17	5.58	79
950	79.17	18.27	2.60	285	23 75	5.48	78
925	77.08	17.79	2.53	280	23.33	5.38	77
900	75 00	17.31	2.47	275	22 92	5.29	75
875	72.92	16.83	2.40	270	22.50	5.19	74
850	70.83	16 35	2.33	260	21.67	5 00	71
825	68.75	15.87	2.26	250	20.80	4.81	69
800	66.67	15.38	2.19	240	20.00	4.62	66
775	64.58	14.90	2.12	235	19 58	4 52	64
750	62.50	14 42	2.05	230	19.17	4 42	63
725	60.42	13.94	1 99	225	18.75	4 33	62
700	58.33	13.46	1.92	220	18.33	4 23	60
675	56.25	12.99	1.85	215	17.92	4 13	59
650	54 17	12.50	1.78	210	17.50	4 04	58
625	52.08	12.02	1.71	205	17.08	3.94	56
600	50.00	11.54	1.64	200	16.67	3 85	55
575	47.92	11.06	1.58	195	16.25	3.75	53
550	45.83	10 58	1.54	190	15.83	3.64	52
525	43.75	10.10	1.44	185	15.42	3.56	51
500	41.67	9.62	1.37	180	15.00	3 46	49
475	39.58	9.13	1.30	175	14.58	3.37	48
450	37.50	8.66	1.23	170	14.17	3 27	47
425	35.42	8.17	1.16	165	13.75	3 17	45
400	33.33	7.69	1.10	160	13 33	3.08	44
390	32.50	7.50	1.07	155	12.92	2.98	42
380	31.67	7.31	1.04	150	12.50	2.88	41
375	31.25	7.21	1.03	145	12.08	2.79	40
370	30.83	7.12	1.01	140	11.67	2 69	38
360	30.00	6.92	.99	135	11.25	2.60	37
350	29.17	6.73	.96	130	10.83	2 50	36
340	28.33	6.54	.93	125	10 42	2 40	34
330	27.50	6.35	.90	120	10.00	2 31	33
325	27 08	6.25	.89	115	9.58	2.21	31
320	26 67	6.15	.88	110	9.17	2.11	30
310	25.83	5.96	.85	105	8.75	2 02	29
300	25.00	5.77	.82	100	8.33	1.92	27

TABLE OF BOARD OR RENT, BY THE WEEK, SHOWING IT FOR DAYS.

.25	.50	.75	$1	$2	$3	$4	$5	Days.	$6	$8	$9	$10	$11	$12	$15
.02	.04	.05	.07	.14	.21	.29	.36	½	.43	.57	.64	.71	.79	.86	1.07
.04	.07	.11	.14	.29	.43	.57	.71	1	.86	1.14	1.29	1.43	1.57	1.71	2.14
.07	.14	.20	.29	.57	.86	1.14	1.43	2	1.71	2.29	2.57	2.86	3.14	3.43	4.29
.11	.21	.32	.43	.86	1 29	1.71	2.14	3	2.57	3.43	3.86	4.29	4.71	5.14	6.43
.14	.29	.43	.57	1.14	1.71	2.29	2.86	4	3.43	4.57	5.14	5.71	6.29	6.86	8.57
.18	.36	.54	.71	1.43	2.14	2.86	3.57	5	4.29	5.71	6.43	7.14	7.86	8.57	10.71
.21	.43	.64	.86	1.71	2.57	3.43	4.29	6	5.14	6.86	7.71	8.57	9.43	10.29	12.86
.25	.50	.75	1.00	2.00	3.00	4.00	5 00	7	6.00	8.00	9.00	10.00	11 00	12.00	15.00

TABLE OF WAGES

For One Week, Two Weeks, Three Weeks, or Four Weeks.

	Days.	$1.00	$1.50	$2.00	$2.50	$3.00	$3.50	$4.00	$4.50	$5.00	$5.50	$6.00
First Week.	1	.16⅔	.25	.33⅓	.41⅔	.50	.58⅓	.66⅔	.75	.83⅓	.91⅔	1.00
	2	.33⅓	.50	.66⅔	.83⅓	1.00	1.16⅔	1.33⅓	1.50	1.66⅔	1.83⅓	2.00
	3	.50	.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00
	4	.66⅔	1.00	1.33⅓	1.66⅔	2.00	2.33⅓	2.66⅔	3.00	3.33⅓	3.66⅔	4.00
	5	.83⅓	1.25	1.66⅔	2.08⅓	2.50	2.91⅔	3.33⅓	3.75	4.16⅔	4.58⅓	5.00
	6	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00
2nd Week.	7	1.16⅔	1.75	2.33⅓	2.91⅔	3.50	4.08⅓	4.66⅔	5.25	5.83⅓	6.41⅔	7.00
	8	1.33⅓	2.00	2.66⅔	3.33⅓	4.00	4.66⅔	5.33⅓	6.00	6.66⅔	7.33⅓	8.00
	9	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50	8.25	9.00
	10	1.66⅔	2.50	3.33⅓	4.16⅔	5.00	5.83⅓	6.66⅔	7.50	8.33⅓	9.16⅔	10.00
	11	1.83⅓	2.75	3.66⅔	4.58⅓	5.50	6.41⅔	7.33⅓	8.25	9.16⅔	10.08⅓	11.00
	12	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00
3rd Week.	13	2.16⅔	3.25	4.33⅓	5.41⅔	6.50	7.58⅓	8.66⅔	9.75	10.83⅓	11.91⅔	13.00
	14	2.33⅓	3.50	4.66⅔	5.83⅓	7.00	8.16⅔	9.33⅓	10.50	11.66⅔	12.83⅓	14.00
	15	2.50	3.75	5.00	6.25	7.50	8.75	10.00	11.25	12.50	13.75	15.00
	16	2.66⅔	4.00	5.33⅓	6.66⅔	8.00	9.33⅓	10.66⅔	12.00	13.33⅓	14.66⅔	16.00
	17	2.83⅓	4.25	5.66⅔	7.08⅓	8.50	9.91⅔	11.33⅓	12.75	14.16⅔	15.58⅓	17.00
	18	3.00	4.50	6.00	7.50	9.00	10.50	12.00	13.50	15.00	16.50	18.00
4th Week.	19	3.16⅔	4.75	6.33⅓	7.91⅔	9.50	11.08⅓	12.66⅔	14.25	15.83⅓	17.41⅔	19.00
	20	3.33⅓	5.00	6.66⅔	8.33⅓	10.00	11.66⅔	13.33⅓	15.00	16.66⅔	18.33⅓	20.00
	21	3.50	5.25	7.00	8.75	10.50	12.25	14.00	15.75	17.50	19.25	21.00
	22	3.66⅔	5.50	7.33⅓	9.16⅔	11.00	12.83⅓	14.66⅔	16.50	18.33⅓	20.16⅔	22.00
	23	3.83⅓	5.75	7.66⅔	9.58⅓	11.50	13.41⅔	15.33⅓	17.25	19.16⅔	21.08⅓	23.00
	24	4.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00	22.00	24.00

	Days.	$6.50	$7.00	$7.50	$8.00	$9.00	$10	$11	$12	$13	$14	$15
First Week.	1	1.08⅓	1.16⅔	1.25	1.33⅓	1.50	1.66⅔	1.83⅓	2.00	2.16⅔	2.33⅓	2.50
	2	2.16⅔	2.33⅓	2.50	2.66⅔	3.00	3.33⅓	3.66⅔	4.00	4.33⅓	4.66⅔	5.00
	3	3.25	3.50	3.75	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50
	4	4.33⅓	4.66⅔	5.00	5.33⅓	6.00	6.66⅔	7.33⅓	8.00	8.66⅔	9.33⅓	10.00
	5	5.41⅔	5.83⅓	6.25	6.66⅔	7.50	8.33⅓	9.16⅔	10.00	10.83⅓	11.66⅔	12.50
	6	6.50	7.00	7.50	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00
2nd Week.	7	7.58⅓	8.16⅔	8.75	9.33⅓	10.50	11.66⅔	12.83⅓	14.00	15.16⅔	16.33⅓	17.50
	8	8.66⅔	9.33⅓	10.00	10.66⅔	12.00	13.33⅓	14.66⅔	16.00	17.33⅓	18.66⅔	20.00
	9	9.75	10.50	11.25	12.00	13.50	15.00	16.50	18.00	19.50	21.00	22.50
	10	10.83⅓	11.66⅔	12.50	13.33⅓	15.00	16.66⅔	18.33⅓	20.00	21.66⅔	23.33⅓	25.00
	11	11.91⅔	12.83⅓	13.75	14.66⅔	16.50	18.33⅓	20.16⅔	22.00	23.83⅓	25.66⅔	27.50
	12	13.00	14.00	15.00	16.00	18.00	20.00	22.00	24.00	26.00	28.00	30.00
3rd Week.	13	14.08⅓	15.16⅔	16.25	17.33⅓	19.50	21.66⅔	23.83⅓	26.00	28.16⅔	30.33⅓	32.50
	14	15.16⅔	16.33⅓	17.50	18.66⅔	21.00	23.33⅓	25.66⅔	28.00	30.33⅓	32.66⅔	35.00
	15	16.25	17.50	18.75	20.00	22.50	25.00	27.50	30.00	32.50	35.00	37.50
	16	17.33⅓	18.66⅔	20.00	21.33⅓	24.00	26.66⅔	29.33⅓	32.00	34.66⅔	37.33⅓	40.00
	17	18.41⅔	19.83⅓	21.25	22.66⅔	25.50	28.33⅓	31.16⅔	34.00	36.83⅓	39.66⅔	42.50
	18	19.50	21.00	22.50	24.00	27.00	30.00	33 00	36.00	39 00	42.00	45.00
4th Week.	19	20.58⅓	22.16⅔	23.75	25.33⅓	28.50	31.66⅔	34.83⅓	38.00	41.16⅔	44.33⅓	47.50
	20	21.66⅔	23.33⅓	25.00	26.66⅔	30.00	33.33⅓	36.66⅔	40.00	43.33⅓	46.66⅔	50.00
	21	22.75	24.50	26.25	28 00	31.50	35.00	38 50	42.00	45.50	49.00	52.50
	22	23.83⅓	25.66⅔	27.50	29.33⅓	33.00	36.66⅔	40.33⅓	44.00	47.66⅔	51.33⅓	55.00
	23	24.91⅔	26.83⅓	28.75	30.66⅔	34 50	38.33⅓	42.16⅔	46.00	49.83⅓	53.66⅔	57.50
	24	26.00	28.00	30.00	32 00	36.00	40.00	44 00	48.00	52.00	56 00	60.00

TABLE OF WAGES BY THE WEEK, FROM $2 TO $20.

$2	$2½	$3	$3½	$4	$4½	$5	Days	$7	$8	$9	$10	$12	$15	$20
.29	.36	.43	.50	.57	.64	.71	1	1.00	1.14	1.29	1.43	1.71	2.14	2.86
.08	.10	.13	.15	.17	.19	.21	¼	.29	.33	.38	.42	.50	.63	.83
.17	.21	.25	.29	.33	.38	.42	⅓	.58	.67	.75	.83	1.00	1.25	1.67
.25	.31	.38	.44	.50	.56	.63	⅔	.88	1.00	1.13	1.25	1.50	1.88	2.50
.33	.42	.50	.58	.67	.75	.83	1	1.17	1.33	1.50	1.67	2.00	2.50	3.33
.50	.63	.75	.88	1.00	1 13	1.25	1½	1.75	2.00	2.25	2.50	3.00	3.75	5.00
.67	.83	1.00	1.17	1.33	1.50	1.67	2	2.33	2.67	3.00	3.33	4.00	5.00	6.67
.83	1.04	1.25	1.46	1.67	1.88	2.08	2½	2.92	3.33	3.75	4.17	5.00	6.25	8.33
1.00	1.25	1.50	1.75	2.00	2.25	2.50	3	3.50	4.00	4.50	5.00	6.00	7.50	10.00
1.17	1.46	1.75	2.04	2.33	2.63	2.92	3½	4.08	4.67	5.25	5.83	7.00	8.75	11.67
1.33	1.67	2.00	2.33	2.67	3.00	3.33	4	4.67	5.33	6.00	6.67	8.00	10.00	13.33
1.50	1.88	2.25	2.63	3.00	3.38	3.75	4½	5.25	6.00	6.75	7.50	9.00	11.25	15 00
1.67	2.08	2.50	2.92	3.33	3.75	4.17	5	5.83	6.67	7.50	8 33	10.00	12.50	16.67
1 83	2.29	2.75	3.21	3.67	4.13	4.58	5½	6.42	7.33	8.25	9.17	11.00	13.75	18.33
2.00	2.50	3.00	3.50	4.00	4.50	5.00	6	7.00	8.00	9.00	10.00	12.00	15.00	20.00

EXPLANATIONS.—The rate per week will be found in the top lines, and the time, in the middle columns. For example, at $7 per week, the wages for four-and-a-half days will amount to $5.25.

TABLE OF WAGES BY THE DAY.—*The 10 Hour System.*

$1	$1¼	$1½	$1¾	$2	$2¼	$2½	Hours.	$2¾	$3	$3¼	$3½	$4	$4½	$5
.10	.13	.15	.18	.20	.23	.25	1	.28	.30	.33	.35	.40	.45	.50
.20	.25	.30	.35	.40	.45	.50	2	.55	.60	65	.70	.80	.90	1.00
.30	.38	.45	.53	.60	.68	.75	3	.83	.90	98	1.05	1.20	1.35	1.50
.40	.50	.60	.70	.80	.90	1.00	4	1.10	1.20	1.30	1.40	1.60	1.80	2.00
.50	.63	.75	.88	1.00	1.13	1.25	5	1.38	1.50	1.63	1.75	2.00	2.25	2.50
.60	.75	.90	1.05	1.20	1.35	1.50	6	1 65	1.80	1.95	2.10	2.40	2.70	3.00
.70	.88	1.05	1.23	1.40	1.58	1.75	7	1.93	2.10	2 28	2.45	2.80	3.15	3.50
.80	1.00	1.20	1.40	1.60	1.80	2.00	8	2 20	2.40	2.60	2.80	3 20	3.60	4.00
.90	1.13	1.35	1.58	1.80	2.03	2.25	9	2.48	2.70	2.93	3.15	3.60	4.05	4.50
1 00	1 25	1 50	1.75	2 00	2.25	2.50	10	2.75	3.00	3.25	3.50	4.00	4.50	5.00

TABLE OF WAGES BY THE DAY.—*The 8 Hour System.*

$1	$1¼	$1½	$1¾	$2	$2¼	$2½	Hours.	$2¾	$3	$3¼	$3½	$4	$4½	$5
.13	.16	.19	.22	.25	.28	.31	1	.34	.38	.41	.44	.50	.56	.63
.25	.31	.38	.44	.50	.56	.63	2	.69	.75	.81	.88	1.00	1.13	1.25
.38	.47	.56	.66	.75	.84	.94	3	1.03	1.13	1.22	1.31	1.50	1.69	1.88
.50	.63	.75	.88	1.00	1.13	1.25	4	1.38	1.50	1.63	1 75	2 00	2 25	2.50
.63	.78	.94	1.09	1.25	1.41	1.56	5	1.72	1.88	2.03	2 19	2 50	2 81	3.13.
.75	.94	1.13	1.31	1.50	1.69	1.88	6	2.06	2.25	2.44	2.63	3 00	3 38	3 75
.88	1.09	1.31	1.53	1.75	1.97	2.19	7	2.41	2.63	2.84	3 06	3.50	3 94	4 38
1.00	1.25	1.50	1.75	2 00	2.25	2 50	8	2.75	3 00	3 25	3 50	4 00	4 50	5 00

TABLE OF WAGES BY THE WEEK.

Ten Hours Per Day.

Per Week.	5 Days.	4 Days.	3 Days.	2 Days.	1 Day.	½ Day.	¼ Day.	1 Hour.
2.00	1.66⅔	1.33⅓	1.00	.66⅔	.33⅓	.16.66	. 8 33	3.56
2.50	2.08⅓	1.66⅔	1.25	.80⅓	.21⅔	.20 08	.10 ⅓	4 ⅛
3.50	2.91⅔	2.33⅓	1.75	1.16⅔	.58⅓	.29 ⅛	.14 ⅓	5.08
4.00	3.33⅓	2.66⅔	2.00	1.33⅓	.66⅔	.33 33	.16.66	6 66
4.50	3.75	3.00	2.25	1.50	.75	.37 ½	.18 ¾	7 ½
5.00	4.16⅔	3.33⅓	2.50	1.66⅔	.83⅓	.41.66	.20 08	8 33
5.50	4.58⅓	3.66⅔	2.75	1.83⅓	.91⅔	.45.08	.22 23	9 ⅛
6.00	5.41⅔	4.33⅓	3.25	2.16⅔	1.08⅓	.54 ⅛	.27.12	10.08
7.00	5.83⅓	4.66⅔	3.50	2.33⅓	1.16⅔	.58.33	.29 ⅛	11.66
7.50	6.25	5.00	3.75	2.50	1.25	.62 ½	.31 ¼	12 ½
8.00	6.66⅔	5.33⅓	4.00	2 66⅔	1.33⅓	.66.66	.33 33	13.33
9.00	7.50	6.00	4.50	3.00	1.50	.75	.37 ½	15
10.00	8.33⅓	6.66⅔	5.00	3.33⅓	1.66⅔	.83.33	.41.66	16 66
11.00	9.16⅔	7.33⅓	5.50	3.66⅔	1.83⅓	.91.66	.45.08	18.33
13.00	10.83⅓	8.66⅔	6.50	4.33⅓	2.16⅔	1.08.33	.54 ⅛	21.66
14.00	11.66⅔	9.33⅓	7.00	4.66⅔	2.33⅓	1.10.66	.58.66	23 33
16.00	13.33⅓	10.66⅔	8.00	5.36⅓	2.66⅔	1.33.33	.66.66	26 66
17.00	14.16⅔	11.33⅓	8.58	5.66⅔	2.83⅓	1.41.66	.70.08	28.33
19 00	15.83⅓	12.66⅔	9.50	6.33⅓	3.16⅔	1.58.33	.70 ⅛	31.66
20.00	16.66⅔	13.33⅓	10.00	6.66⅔	3.33⅓	1.66.66	.88.33	33.33
21.00	17.50	14.00	10.50	7.00	3.50	1.75	.87 ½	35
22.00	18.33⅓	14.66⅔	11.00	7.33⅓	3.66⅔	1.83.33	.91.66	36.66
23.00	19.16⅔	15.33⅓	11.50	7.66⅔	3.83⅓	1.91.66	.95.08	38.33
25.00	20.83⅓	16.66⅔	12.50	8.33⅓	4.16⅔	2.08.33	1.01 ¢	41.66

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